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067-0916-00

VIDEO AMPLITUDE CALIBRATION FIXTURE

INSTRUCTION MANUAL

Tektronix, Inc.
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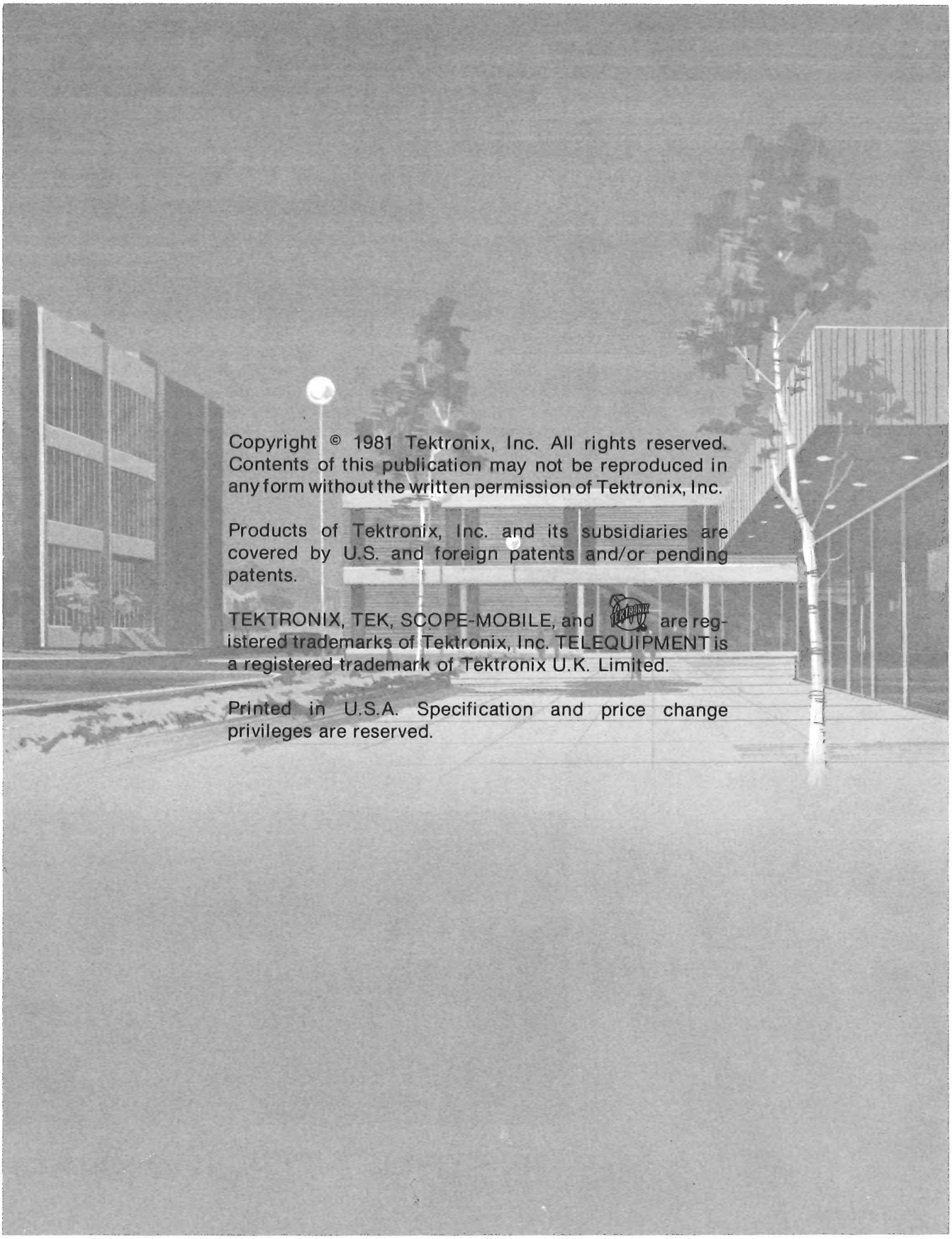

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TABLE OF CONTENTS

WARNING

THE FOLLOWING SERVICE INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

LIST OF ILLUSTRATIONS

The following illustrations are located in the diagram pull-out section.

LIST OF TABLES

OPERATORS SAFETY SUMMARY

The general safety information in this part of the summary is for both operating and servicing personnel. Specific warnings and cautions will be found throughout the manual where they apply, but may not appear in this summary.

TERMS

In This Manual

CAUTION statements identify conditions or practices that could result in damage to the equipment or other property.

WARNING statements identify conditions or practices that could result in personal injury or loss of life.

As Marked on Equipment

CAUTION indicates a personal injury hazard not immediately accessible as one reads the marking, or a hazard to property including the equipment itself.

DANGER indicates a personal injury hazard immediately accessible as one reads the marking.

SYMBOLS

In This Manual

This symbol indicates where applicable cautionary or other information is to be found.

As Marked on Equipment

DANGER — High voltage.

Protective ground (earth) terminal.

ATTENTION — refer to manual.

Power Source

This product is intended to operate from dc supplies in a mainframe whose power source will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Grounding the Product

This product is grounded through the grounding conductor of the power cord of the mainframe. To avoid electrical shock, plug the mainframe power cord into a properly wired receptacle before connecting to the product input or output terminals. A protective ground connection by way of the grounding conductor in the power cord is essential for safe operation.

Danger Arising From Loss of Ground

Upon loss of the protective-ground connection, all accessible conductive parts (including knobs and controls that may appear to be insulating) can render an electric shock.

Use the Proper Fuse

To avoid fire hazard, use only the fuse of correct type, voltage rating and current rating as specified in the parts list for your product.

Refer fuse replacement to qualified service personnel.

Do Not Operate in Explosive Atmospheres

To avoid explosion, do not operate this product in an explosive atmosphere unless it has been specifically certified for such operation.

Do Not Operate Without Covers

To avoid personal injury, do not operate this product without covers or panels installed. Do not apply power to the plug-in via a plug-in extender.

SERVICE SAFETY SUMMARY

FOR QUALIFIED SERVICE PERSONNEL ONLY

Refer also to the preceding Operators Safety Summary.

Do Not Service Alone

Do not perform internal service or adjustment of this product unless another person capable of rendering first aid and resuscitation is present.

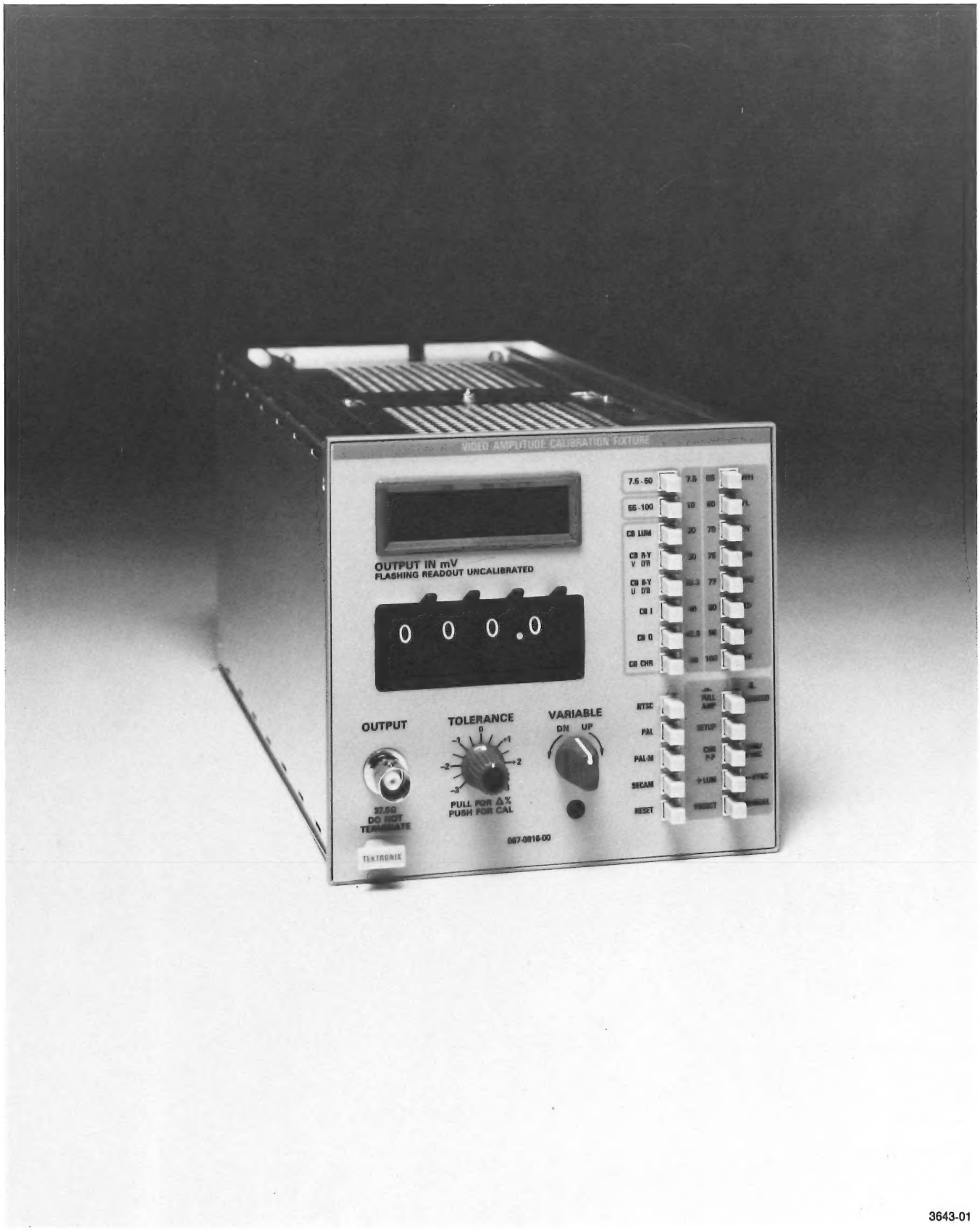
Use Care When Servicing With Power On

Dangerous voltages may exist at several points in this product. To avoid personal injury, do not touch exposed connections and components while power is on.

Disconnect power before removing protective panels, soldering, or replacing components.

Power Source

This product is intended to operate from dc supplies in a mainframe whose power source will not apply more than 250 volts rms between the supply conductors or between either supply conductor and ground. A protective ground connection by way of the grounding conductor in the mainframe power cord is essential for safe operation.



Video Amplitude Calibration Fixture.

SPECIFICATION

Introduction

The 067-0916-00 Video Amplitude Calibration Fixture (VAC) is a high-precision test fixture used in the measurement of common video test signals, and the calibration of video test signal generators and waveform monitors. It provides a simple means of measuring and calibrating luminance and chrominance signals associated with most video test signals.

A low-impedance output on the VAC provides a precise-amplitude square wave voltage with a resolution of 0.1 mV and an accuracy of 0.05% from 0 to 999.9 mV peak. The precision reference voltage is selected either by setting lever switches of a 4-decade counter on the front panel, or by selecting preset values for the most common signal element amplitudes, which are stored in an EPROM. Two front-panel controls provide for varying the output voltage to determine the actual test-signal amplitude or percent of deviation. Other pushbuttons select the color standards (NTSC, PAL, PAL M, or SECAM) and other signal parameters such as half or full amplitude at the output connector.

The video signal to be measured is connected to a 1480-Series Waveform Monitor "A" input. The VAC's output is connected to the waveform monitor "B" input. The "A-B" differential mode of the waveform monitor then permits convenient comparison of signal amplitudes.

The VAC is packaged in a 2-wide TM500 module to take advantage of existing test gear at most testing and servicing locations.

When making chrominance measurements, odd harmonics generated by the subcarrier make peak-to-peak measurements of the chrominance packets an uncertainty. To obtain maximum performance from the VAC when making these measurements, a Subcarrier Harmonic Rejection Filter 015-0407-00 (5 Mhz lowpass) is placed between the signal generator under test and the waveform monitor. Because the 015-0407-00 filter has a 0.6% passband loss, a 0.6% attenuator (011-0134-00) is placed between the VAC and the waveform monitor, thus compensating for the loss. Useful but less accurate measurements can be made without the use of the filter and attenuator.

Performance Conditions

The following electrical characteristics are valid only if the VAC is calibrated at an ambient temperature of 25° ±3°C and is operated at a normal ambient temperature between 15° and 35°C. Operation over the maximum range of 0° to 50°C may result in reduced amplitude accuracy of ±(0.1% + 0.2 mV). Allow a 20-minute warm up period before performing verification tests.

Table 1-1

ELECTRICAL CHARACTERISTICS

Characteristics	Performance Requirements	Supplemental Information
Output Signal		
Front OUTPUT Connector	37.5 Ω	Bnc connector located on front panel.
Rear Interconnect	0.0 Ω	Rear edge connector pins 27A and 28A.
Amplitude Range (TOLERANCE disabled)	0 mV to 999.9 mV ±(0.05% + 0.1 mV)	Peak-to-peak square wave amplitude.
Amplitude Range (TOLERANCE enabled)	0 mV to 999.9 mV ±(0.5% + 0.1 mV) + TOLERANCE reading	Peak-to-peak square wave amplitude.
Offset		1 mV typical.
VARIABLE Control		2 counts per sec. to 200 counts per sec.
Resolution	0.1 mV	
Risetime		Less than 1 μs.
Frequency		
NTSC, PAL M		270 Hz nominal.
PAL, SECAM		275 Hz nominal.
Waveform		Square wave.
Half Period		
NTSC		9 lines nominal.
PAL		11 lines nominal.
Noise	Less than 1 mV	0 to 5 MHz.

Table 1-2

ENVIRONMENTAL CHARACTERISTICS

Characteristics	Description
Nominal Operating Temperature	+15°C to +35°C
Maximum Operating Temperature	0°C to +50°C
Storage Temperature	-40°C to +65°C
Operating Altitude	To 4,572 m (15,000 feet)
Storage Altitude	To 15,240 m (50,000 feet)

Table 1-3

PHYSICAL CHARACTERISTICS

Characteristics	Description
Length	19.49 cm (7.675 inches)
Width	21.40 cm (8.424 inches)
Height	49.72 cm (19.575 inches)
Net Weight	1.38 kg (3.04 lbs)
Net Shipping Weight	4.53 kg (10.0 lbs)

OPERATING INSTRUCTIONS

Installation and Removal Instructions

The VAC is calibrated and ready to use when received. It operates in any of two compartments of the TEKTRONIX TM 500 series power modules except the TM 501. Refer to the power module instruction manual for line-voltage requirements and power module operation.

CAUTION

Turn the power module off before inserting or removing the VAC; otherwise arcing may occur at the rear interface connectors. Arcing reduces the useful life of the connectors and damage may be done to the plug-in circuitry.

Check for plastic barriers on the interconnecting jacks of the power module in the selected compartments. If the barriers do not match the cutouts in the VAC circuit board edge connector, they may indicate special rear interface connections for another type of instrument. Do not insert the plug-in until this has been verified by qualified service personnel.

The TM 500 power module MUST have a barrier installed between pins 6 and 7 at the standard barrier location to ensure proper connector alignment. The TM 500 Power Module may also have an optional barrier between pins 27 and 28 to indicate that the compartment is reserved for TM 500 plug-ins in the Signal Source family. A barrier in any other location will preclude insertion of the VAC, because that barrier would indicate that the compartment has been reserved for TM 500 plug-ins other than those in the Signal Source family.

When the units are properly matched, align the VAC with the upper and lower guides (see Fig. 2-1) or the selected compartments. Insert the VAC into the compartment and press firmly to seat the circuit boards in the interconnecting

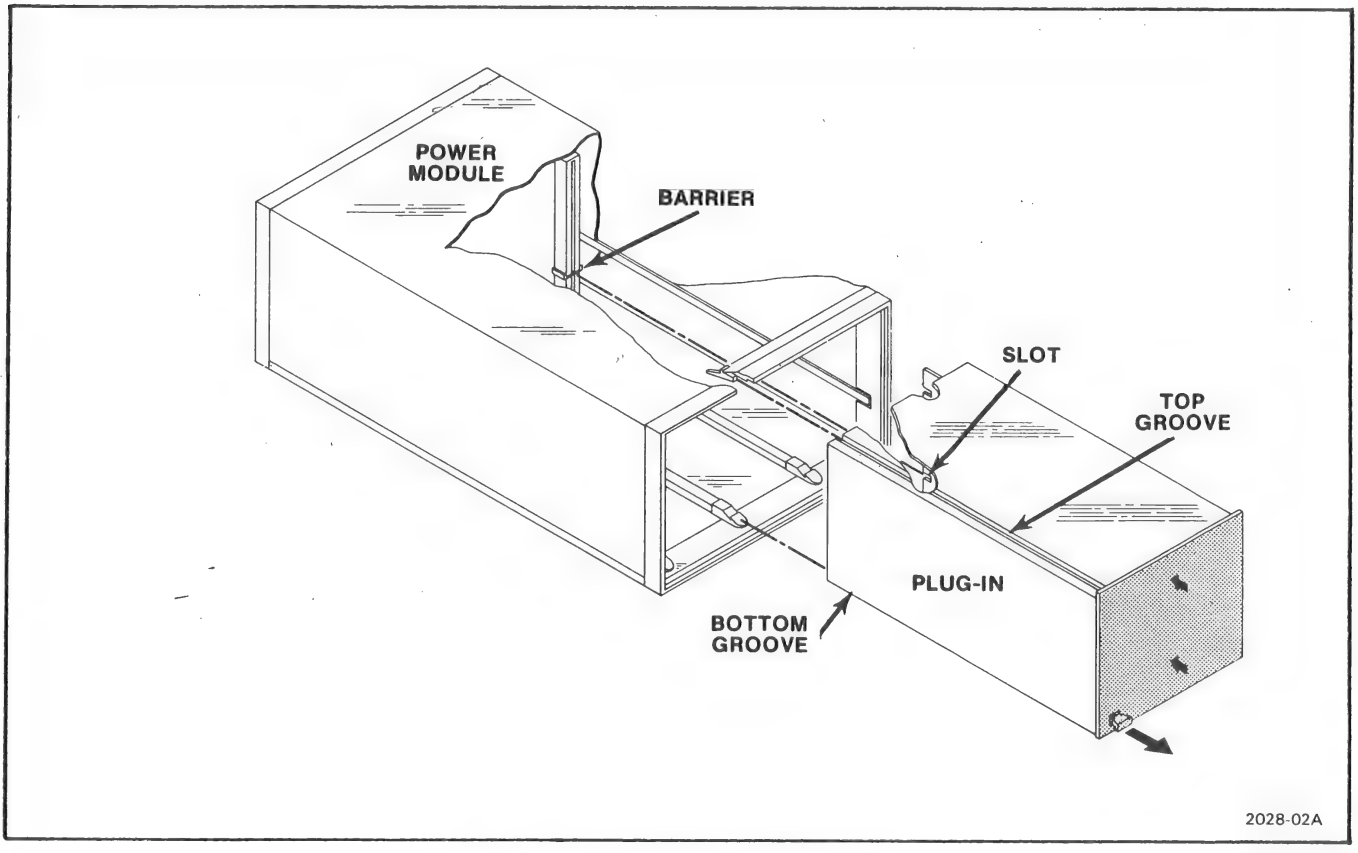


Fig. 2-1. VAC Installation and Removal.

jacks. The VAC readout should be illuminated when the power signal switch switch is turned on.

To remove the VAC, turn off the TM 500 Power Module and pull the release latch, located on the lower left corner of the VAC, until the connector disconnects from the power module. The VAC will now slide out of the power module.

OPERATING CONSIDERATIONS

Output Connections

The output of the VAC is designed primarily to operate as a 37.5 Ω voltage source working into an unterminated 15 kΩ loop through input of a waveform monitor. Normally, the output of a voltage source would be 75 Ω into the 15 kΩ loop through and terminated by 75 Ω. However, with the last setup mentioned as much as .06% error can easily be accumulated via cable loss, voltage source tolerances, and terminator tolerances. Using the 37.5 Ω voltage source, these errors are elimanated.

Loop Through Inputs

Each loop through input of a waveform monitor or other equipment introduces return loss errors which are usually worse at higher frequencies. For best accuracy in gain measurements, do not connect additional equipment to the other input of a loop through input. Instead, terminate at the input with the Tektronix 011-0102-01 75 Ω 0.025% precision terminator. Also, when connecting a signal source to the waveform monitor, use only the low-loss video cables listed below. The shorter cable is preferred. Do not use RG59 75 Ω cable.

42″	Belden 8281	Tektronix part number 012-0159-00
72″	Belden 8281	Tektronix part number 012-0159-01

Subcarrier Harmonic Rejection Filter and Attenuator

When measuring chrominance on a video signal, odd harmonics generated by the subcarrier make total peak-to-peak amplitude measurements an uncertainty as illustrated in Fig. 2-2. For this reason, always use the Tektronix 015-0407-00 Subcarrier Harmonic Rejection Filter between the generator under test and the waveform monitor. The filter will attenuate the odd harmonics approximately 20 dB. The 015-0407-00 filter also has a 0.6% passband loss. This is compensated by also inserting the 011-0134-00 attenuator between the VAC and the waveform monitor. The attenuator cuts the VAC's output by 0.6%, thus cancelling the error created by the filter.

Measurement System Accuracy

When making critical measurements on a video signal, the total specification of the test system should be considered. Table 2-1 gives the accessory specifications. Table 2-2 shows the maximum amount of error each instrument and accessory may introduce in the test system.

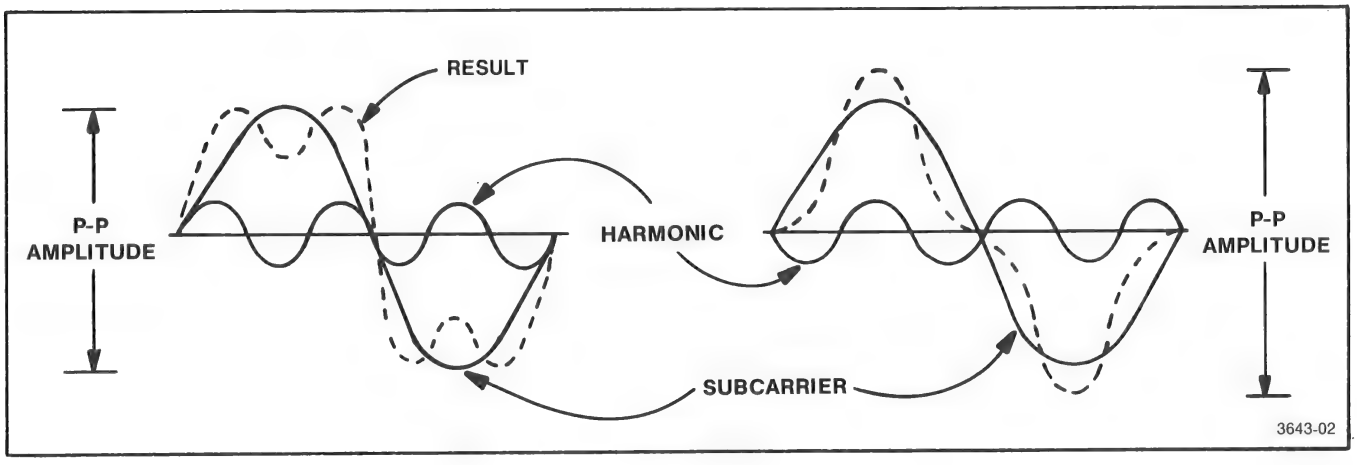


Fig. 2-2. Peak-to-peak Amplitude Distortions.

Table 2-1
ACCESSORY SPECIFICATIONS

011-0101-01	Terminator 75 Ω ±0.025%.
015-0407-00	Subcarrier Harmonic Rejection Filter (5 MHz lowpass) 0.6% ±0.1% attenuation at 50 kHz, 3.58 MHz, and 4.43 MHz.
011-0134-00	Attenuator 0.6% ±0.01%; Zin = 37 Ω, Zload ≈ ∞

Table 2-2
SYSTEM ERROR

Source of Error	Luminance Error	Chrominance Error
067-0916-00 VAC	0.05%	0.05%
1480 Mod W5F Common-Mode-Rejection-Ratio	0.05%	0.05%
1480 Mod W5F Frequency Response	0.0	0.5%
011-0102-01 Terminator	0.0125%	0.0125%
015-0407-00 Filter	Not Used	0.1%
011-0134-00 Attenuator	Not Used	0.01%
TOTAL ERROR	0.1125%	0.7225%

Waveform Monitor Requirements

To take full advantage of the VAC's output accuracy, the waveform monitor used must also meet special performance specifications. Special attention should be paid to the common mode rejection ratio and the A-B frequency response. The frequency response of the waveform monitor used should be ±0.5% from 50 kHz to 5 MHz in the A-B mode with no signal on B. The common mode rejection ratio should be 66 dB from 25 Hz to 50 kHz. The TEKTRONIX 1485R Mod W5F meets these specifications and is recommended for use with the VAC.

NOTE

TEKTRONIX 1480-Series waveform monitors before serial number B070000 had problems turning the clamp all the way off at certain signal levels. Using the VAC with one of these waveform monitors before B070000 may result in a blurred display when making certain measurements. If a problem is suspected, contact your local service center and ask for change reference M39771.

CONTROLS, CONNECTORS, AND INDICATOR LIGHTS

Refer to Fig. 2-3 for the locations of the controls, connectors and indicator lights described below.

(1) 7.5-50, 55-100: Enables the Preset Level switches to be referenced to the values color coded in blue or green for any color standard selected (NTSC, PAL, PAL-M, SECAM). See Table 4-6 for the actual level in mV for each Preset Level selection.

(2) CB LUM, CB R-Y/V D'R, CB B-Y/U D'B: Enables the Preset Level switches to be referenced to the color bar levels coded in brown for any color standards selected using REDUCED or FULL AMP with or without SETUP.

(3) CB I, CB Q: Enables the Preset Level switches to be referenced to the color levels coded in brown for the NTSC color standard only, using REDUCED or FULL AMP with or without SETUP.

(4) CB CHR: Enables the Preset Level switches to be referenced to the Color Levels coded in brown for the NTSC, PAL, or PAL-M color standards only, using REDUCED or FULL AMP with or without SETUP.

(5) FULL AMP/REDUCED: Used with the Preset Level Switches color coded in brown to select either full or reduced amplitude Preset Group settings.

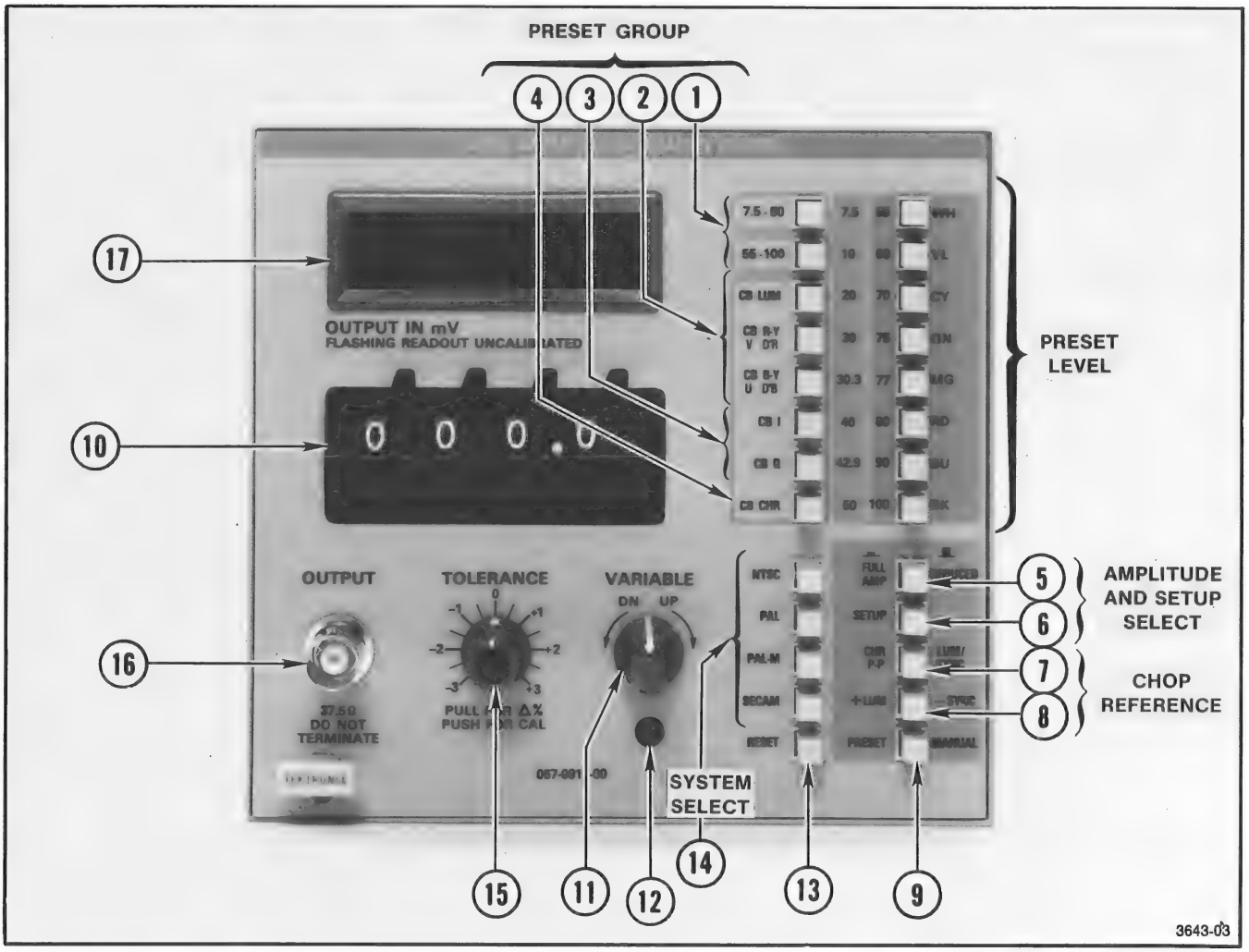


Fig. 2-3. Controls, Connectors, Indicator Lights, and Control Group Settings.

(6) SETUP: Used with the Preset Level switches color coded in brown to insert setup when needed with the Preset Group settings.

(7) CHR P-P or LUM/SYNC: Used for convenience to free the technician from having to adjust the vertical position on the waveform monitor when making chrominance measurements. The CHR P-P mode shifts the original and chopped double equally away from the blanking level when the switched dc amplitude of the VAC is increased. This offers maximum convenience in matching the top of one chrominance envelope with the bottom of the other. The LUM/SYNC mode enables the +LUM/-SYNC button to control which way the reference is offset from the blanking level.

(8) +LUM/-SYNC: Used for convenience to free the technician from having to adjust the vertical position of the waveform monitor when making luminance measurements. When measuring luminance levels, which are more likely to be at the top of the waveform monitor's screen, +LUM enables the reference + offset waveform to travel downward on the monitor screen as the switched dc amplitude of the VAC is increased. When measuring levels below the blanking level, which would be more toward the bottom of the wavefrom monitor screen, -SYNC enables the reference + offset waveform to travel upward on the monitor screen as the switched dc amplitude of the VAC is increased.

(9) PRESET/MANUAL: When the PRESET mode is selected, the OUTPUT of the VAC is referenced from one of the 500-plus Preset Level selections. When the MANUAL mode is selected, the OUTPUT of the VAC can be manually selected by using the four-decade Lever Switches on the front panel of the VAC.

(10) Lever Switches: Four lever switches are combined to make a four-decade control capable of changing the amplitude of the switched dc at the OUTPUT from 000.0 to 999.9 mV peak-to-peak.

(11) VARIABLE: A spring-loaded recentering control. It is used to increase or decrease the switched dc amplitude of the OUTPUT to any value the VAC is capable of producing. The rate of change is proportional to the degree the control is turned. Turning the control 1/4 turn, the readout changes slowly, vs. turning the control 1/2 turn and having the readout change at a faster rate.

(12) VARIABLE LED: Whenever the VARIABLE control is used to change the readout from its preset reference, an LED located below the control lights up. The LED will turn off once the preset selection is changed or the RESET button is pushed.

(13) RESET: The RESET button applies only to the VARIABLE control. The effect of the VARIABLE control is canceled and the OUTPUT returns to the Preset Level reference voltage once the RESET button has been pushed.

(14) NTSC, PAL, PAL-M, SECAM: Used to set the Preset Group information to correct reference voltages for the color standard worked with. See Tables 4-6 through 4-10 for the actual level in mV for each Preset Level selection.

(15) TOLERANCE: A switched variable control which must be pulled out to enable. The TOLERANCE control can change the OUTPUT by approximately ±3% in reference to the output indicated on the readout.

(16) OUTPUT: Bnc connector for VAC output of the switched dc waveform.

(17) Readout: A red four-digit LED indicating the p-p amplitude at the OUTPUT connector in mV. When the TOLERANCE control is enabled, the readout will flash on and off, indicating the instrument is in an uncalibrated mode. FFF.F will appear on the readout when an inappropriate combination of Preset Group and color standard buttons are selected.

APPLICATIONS

The VAC was mainly designed for making measurements of standard video signals. Therefore, the VAC contains most video test signal amplitudes pre-programmed in memory for each video system. This makes it easy for the technician to make signal measurements. Instead of looking up the value needed and dialing it in, the technician need only select the same parameters that the signal generator is set for.

Setting Front-Panel Controls

When the VAC is in the PRESET mode, use the following information to set the front panel controls. Refer to Figure 2-3 for location of button groups mentioned in the following information.

System Select. This selection is determined by the video system being worked with.

Preset Group. This selection is determined by the type of video signal that is being measured. These different "types" basically fall into three categories; video luminance or levels not specifically related to color bars (7.5-50, 55-100), color bar luminance (CB LUM), and color chrominance (CB R-Y/V D'R, CB B-Y/U D'B, CB Q, CB I, CB CHR).

Preset Level. The Preset Level buttons are referenced to the Preset Group buttons. The video luminance selections are outlined in blue and green. The color bar luminance and color chrominance selections are outlined in brown. The Preset Level buttons selection is determined by the parameter of the signal being measured.

Amplitude and Setup Selection. These buttons are used when measuring video signal parameters that are at full or reduced amplitudes. SETUP is used in the same manner.

Reference Offset. This selection is determined by the position of the parameter being measured on the waveform monitor screen. When measuring signals that fall above blanking, use the +LUM mode, and −SYNC when measuring signals that fall below blanking. When making chrominance measurements, always use the CHR P-P mode.

The purpose of having the reference offset buttons is not merely for convenience. In most all waveform monitors, the vertical frequency response changes from the top of the vertical position range to the bottom. Therefore, it would be ideal to leave the vertical position in the same place for all signal parameter measurements. The reference offset buttons make this "ideal" condition possible, which establishes consistent signal measurements in reference to the waveform monitor used. Figures 2-4 through 2-7 illustrate the effect of the reference offset buttons when enabled with respect to the reference signal.

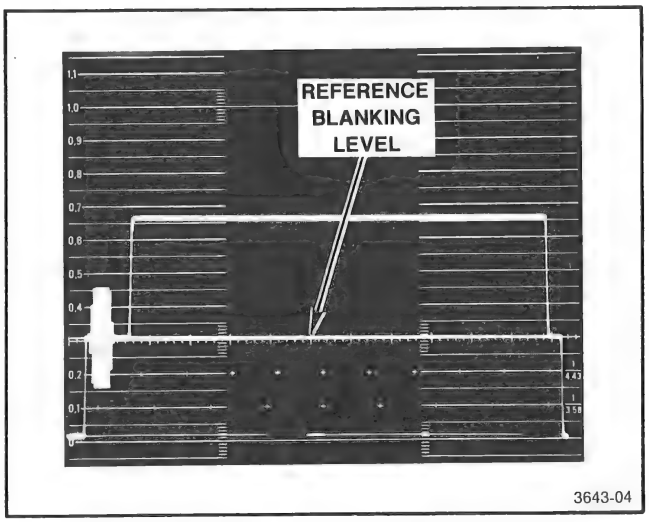


Fig. 2-4. Reference waveform shown without VAC input.

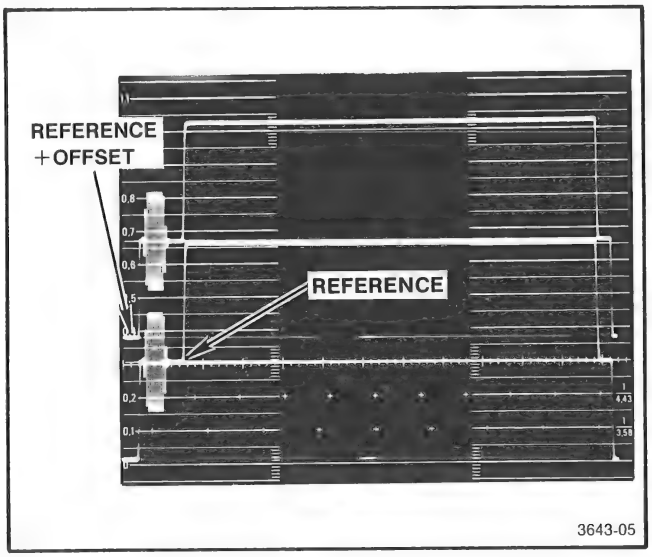


Fig. 2-5. With the −SYNC reference offset mode enabled the "Reference + Offset" waveform appears above the "Reference" waveform. Measurements are made by matching the baseline of the "Reference" waveform to a certain parameter of the "Reference + Offset" waveform that's lower than its own baseline (such as sync).

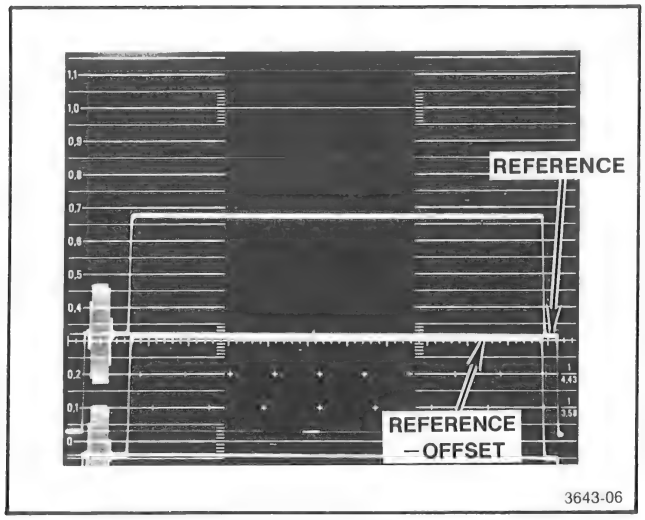


Fig. 2-6. With the +LUM reference offset mode enabled the "Reference − Offset" waveform appears above the "Reference" waveform. Measurements are made by matching the baseline of the "Reference" waveform to a certain parameter of the "Reference − Offset" waveform that's above its own baseline (such as the luminance bar shown being measured).

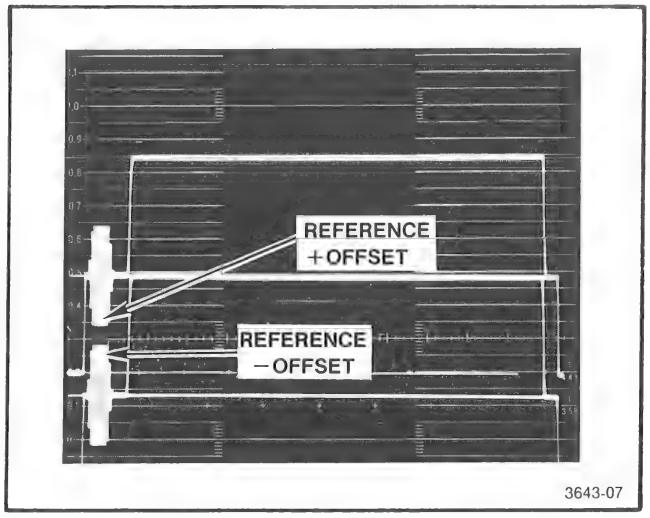


Fig. 2-7. With the CHR P-P reference offset mode enabled both the "Reference + Offset" and the "Reference − Offset" waveforms are shown. Measurements in this mode are usually made of video signals which contain chrominance packets. The measurement is made by matching the top of the "Reference − Offset" waveform with the bottom of the "Reference + Offset" waveform. This is illustrated here using the burst signal of each waveform.

Luminance Measurements

For the following examples, an NTSC composite video signal is used with a 50 IRE bar.

Standard setup for making luminance measurements with the VAC is shown in Figure 2-8. Connect the VAC OUTPUT to the "B" input of the waveform monitor and leave the loop-through unterminated. The signal generator is connected to the "A" input of the waveform monitor with the 012-0159-00 or 012-0159-01 low-loss video cable. Terminate the "A" loop-through with the 011-0102-01 75 Ω 0.025% precision terminator.

Set the VAC front panel controls as follows:

System Select ..... NTSC
Preset Group 7.5-50
Preset Level 50
Chop Reference ..... +LUM
Amplitude and ..... FULL AMP
Setup Select ..... No SETUP

Set the 1485 controls as follows:

Input ..... A-B
Response ..... Flat
Volts Full Scale 1.0
DC Restorer ..... Off

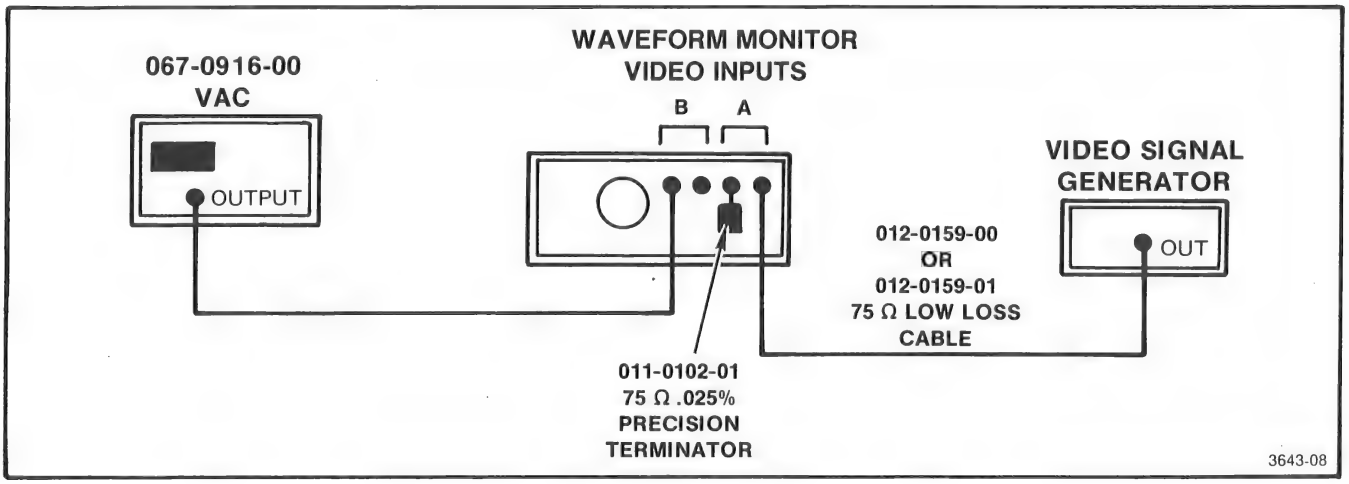


Fig. 2-8. Equipment setup for luminance measurements.

The waveform displayed should look like the one shown in Figure 2-6. The same waveform with the Volts Full Scale on the 1485 changed to 0.2 is shown in Figure 2-9. If the 50 IRE bar is the correct amplitude, the top of the bar from the offset signal will align with the baseline of the reference signal. However, Figure 2-9 shows an obvious error in the 50 IRE bar amplitude. The actual level of the would-be 50 IRE bar may be found by either using the VARIABLE control or setting the VAC in the MANUAL mode and adjusting the Lever Switches to match the top of the bar with the baseline. This is shown in Figure 2-10.

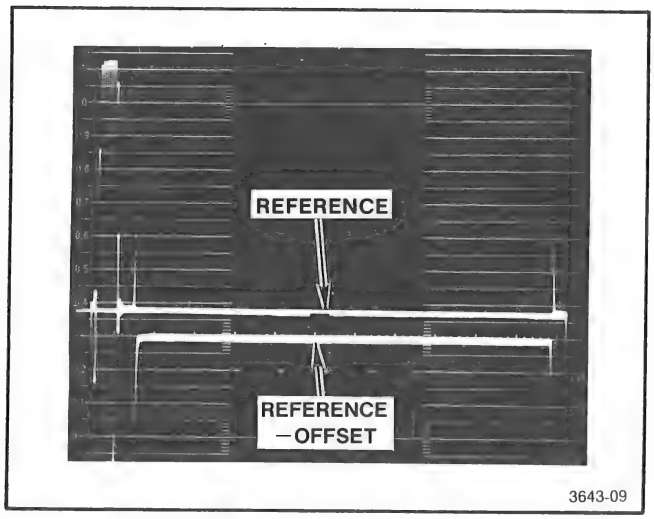


Fig. 2-9. This is the same waveform as shown in Figure 2-6 with the Volts Full Scale on the waveform monitor set to 0.2. This shows an obvious error that cannot be detected at the lower range.

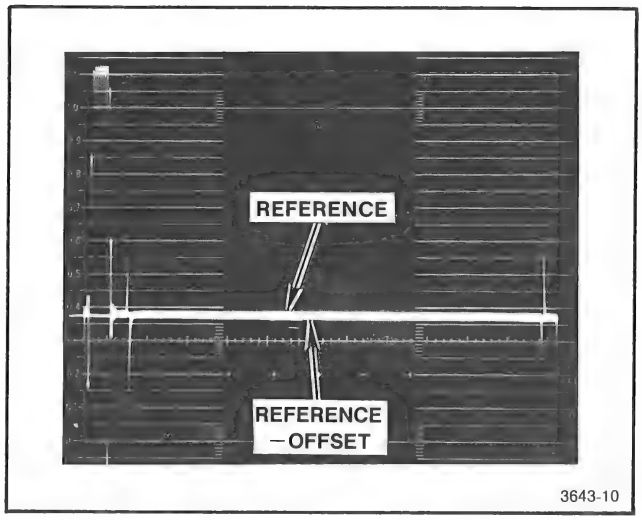


Fig. 2-10. The actual value of the parameter being measured can be found by using the VARIABLE control to match the baseband of the "Reference" waveform with the luminance bar of the "Reference − Offset" waveform.

Chrominance Measurements

The setup for chrominance measurements is the same as the setup used for luminance measurements, except for the addition of the 015-0407-00 filter and a 011-0102-01 attenuator. This setup is illustrated in Figure 2-11. The Subcarrier Harmonic Rejection Filter is placed on the signal generator under test. The 0.6% precision attenuator is placed on the VAC OUTPUT to compensate for the 0.6% pass-band loss of the filter. The CHR P-P chop reference is used for all chrominance measurements, except for CB LUM. When making chrominance measurements, turn off the generator luminance whenever possible.

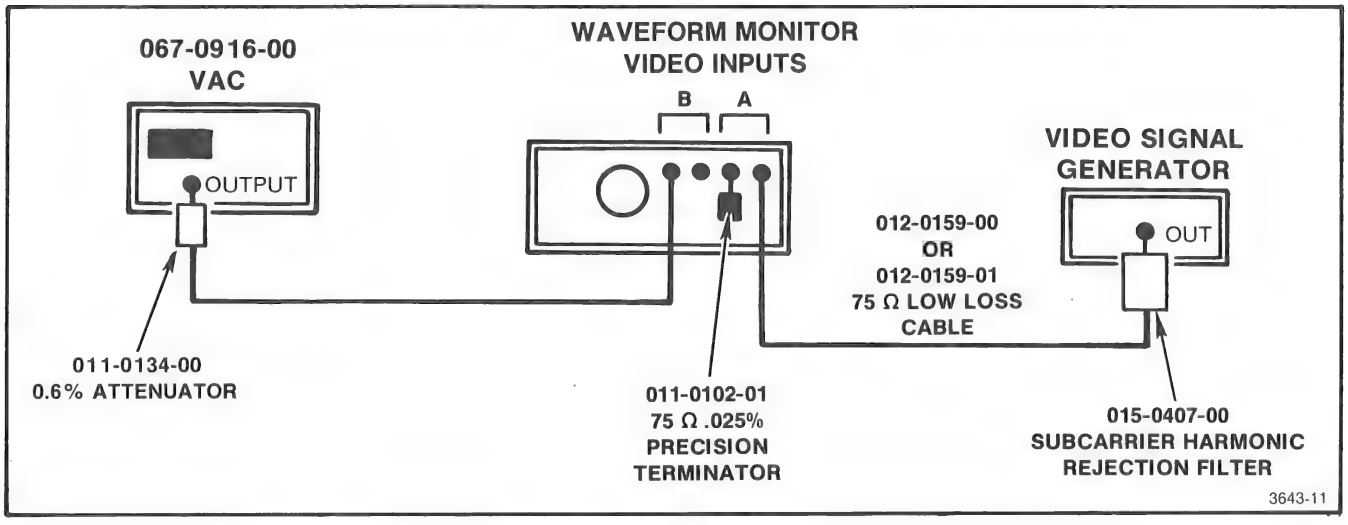


Fig. 2-11. Equipment setup for chrominance measurements.

Set the VAC to measure a full amplitude B-Y blue chrominance packet signal with 7.5% setup.

System Select ..... NTSC
Preset Group ..... CB B-Y/V D'B
Preset Level ..... BL
Chop Reference ..... CHR P-P
Amplitude and ..... FULL AMP
Setup Select ..... SETUP

Set the waveform monitor controls to the same settings that were made when measuring luminance signals.

The waveform displayed should look like the one shown in Figure 2-12. Figure 2-13 is the same waveform with the Volts Full Scale on the waveform monitor set to 0.2. If the blue chrominance packet is the correct amplitude the bottom of the "reference + offset" chrominance packet will align with the top of the "reference - offset" chrominance packet. If an error is detected when making this type of measurement, the amount of error is found by using either the VARIABLE control or the Lever Switches to match the top and bottom of the chrominance packets.

Using the TOLERANCE Control

The TOLERANCE control may be used to measure the percent of deviation from the correct value of a specified signal amplitude to the one actually measured. When measuring video or other signals, the TOLERANCE control has the same effect as the VARIABLE control, the difference in the two controls being the degree each can change a preset or manually generated output of the VAC. The VARIABLE control will change the output to any value the VAC is capable of generating, with the new output being indicated on the readout. The TOLERANCE control will take the value on the readout and change the output in relation to that setting by a percent which is read from the TOLERANCE control dial. For example, if the VAC was set for an output signal of 500 mV, the TOLERANCE control will change the output in a range of ±3% from that setting. Because the amplitude range specification changes from ±(0.5% + 0.1 mV) to ±(0.05% + 0.1 mV) when the TOLERANCE control is enabled, it is not recommended to use the control in this manner. Instead, it may be used to set a reference to one video signal (as required when making relative chrominance measurements) and use the VARIABLE control to make the actual signal measurement without sacrificing the amplitude specification.

Some signal generators have an absolute and relative specification on their chrominance signals. For example, if chrominance amplitude specifications are 1% relative and 3% absolute, the entire chrominance signal may change in gain ±3%. The 1% relative tolerance guarantees that no chrominance signal may change by more than 1% relative to the peak-to-peak amplitude of the red chrominance packet. Thus, all phase angles will be tightly controlled by the 1% specification.

When making absolute and relative chrominance measurements, first measure all the chrominance packets to make sure they fall within the 3% absolute specification. This is done by following the previous explanation on making chrominance measurements. To make the relative measurements, set the VAC to again measure the red chrominance packet. Use the TOLERANCE control to match the peaks of the + and - "reference offset" waveforms if there is any deviation. This references the VAC to the red chrominance packet. Any other measurement made will be offset by exactly the same amount relative to the red chrominance packet. Leave the TOLERANCE control in the same position and remeasure the rest of the chrominance packets for the 1% specification using the VARIABLE control to measure the absolute deviation.

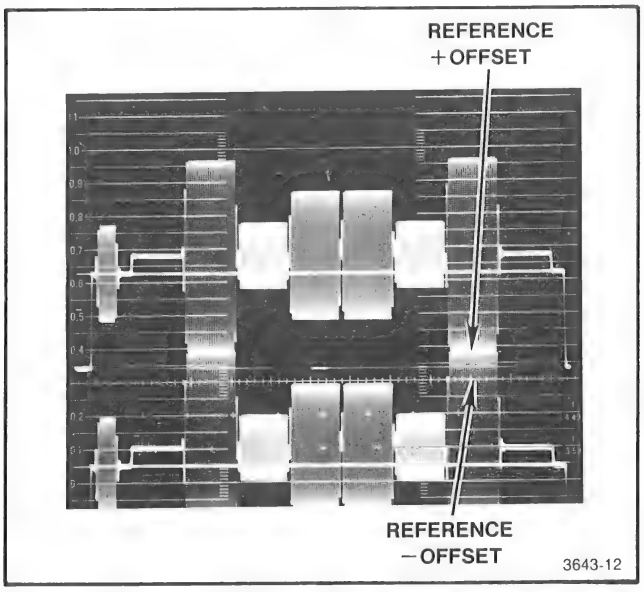


Fig. 2-12. Blue chrominance packets of B-Y NTSC color signal without luminance. The VAC is set in the CHR P-P chop reference mode.

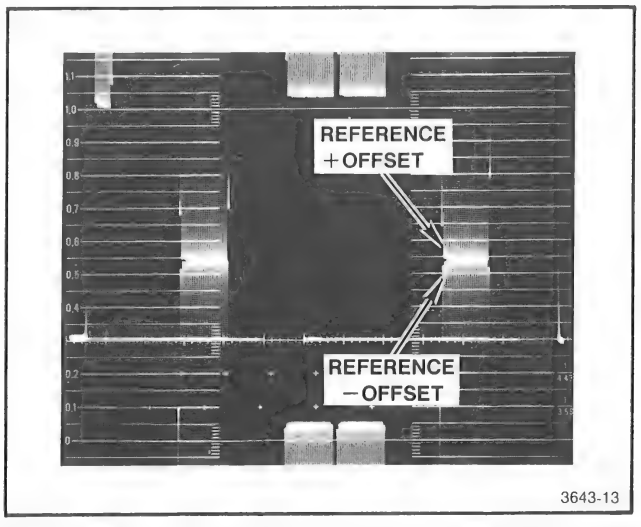


Fig. 2-13. Shown is the same waveform as in Figure 2-12 with the Volts Full Scale on the waveform monitor set to 0.2.

Waveform Monitor Display Calibration

To calibrate the display of a waveform monitor, connect the OUTPUT of the VAC to the A input of the waveform monitor and leave unterminated. See Figure 2-14 for illustration of setup. Set the waveform monitor controls as follows:

Input . . . . . A
Response . . . . . Flat
Volts Full Scale 1.0
DC Restorer . . . . . Off
Operate/Cal . . . . . Operate
Sync . . . . . External

Set the VAC in the Manual mode and dial in any reference voltage needed with the Lever Switches. The display on a waveform monitor with 700.0 mV dialed into the VAC is shown in Figure 2-15 to illustrate the type of waveform expected.

The calibration signal generated by the TEKTRONIX 1480-Series waveform monitors can also be calibrated using the VAC. The setup used is the same as shown in Figure 2-14. The waveform monitor controls are set the same, except the Operate/Cal buttons are both pressed at the same time. Set the VAC in the MANUAL mode and dial in either 700.0 mV for PAL or 714.3 mV for NTSC if the DC RESTORER on the waveform monitor is set for BACK PORCH, or 999.9 if it is set for SYNC TIP. By setting the reference offset of the VAC to the -SYNC mode, the top and bottom of the cal signals should be located at the center of the vertical position range of the waveform monitor. The calibration signal should then be adjusted so the top and bottom of the waveforms meet.

The 37.5 Ω output impedance of the VAC compensates for the loading of the waveform monitor loop through, so subsequent measurements made using the waveform monitor will be corrected for waveform monitor loop through loading. Thus, the correct amplitude into a true 75 Ω load will be displayed.

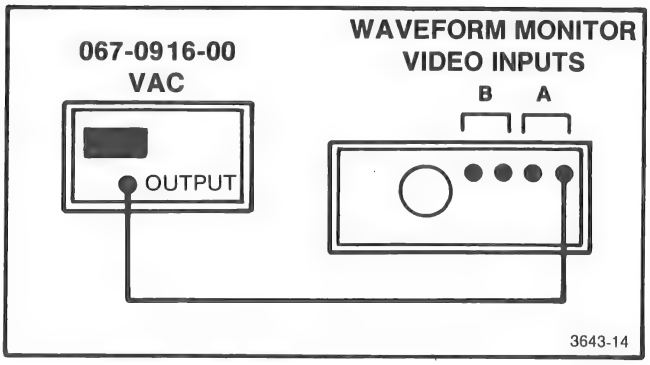


Fig. 2-14. VAC setup for waveform monitor display calibration.

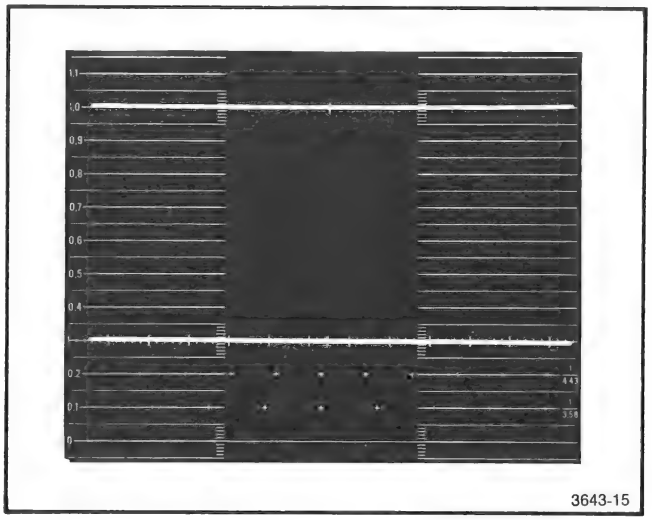


Fig. 2-15. Waveform monitor display of 700.0 mV signal from VAC.

WARNING

THE FOLLOWING SERVICING INSTRUCTIONS ARE FOR USE BY QUALIFIED PERSONNEL ONLY. TO AVOID PERSONAL INJURY, DO NOT PERFORM ANY SERVICING OTHER THAN THAT CONTAINED IN OPERATING INSTRUCTIONS UNLESS YOU ARE QUALIFIED TO DO SO.

THEORY OF OPERATION

Introduction

The following is a description of the electrical circuits in the Video Amplitude Calibration Fixture (VAC). Refer to the block diagram and the schematic diagrams on the foldout pages at the back of the manual to aid in understanding this description.

Block Diagram

The VAC is constructed on four circuit boards. The block diagram shows how the various circuit blocks are organized as well as the circuit board on which each of the circuit blocks is located. Each of the circuit blocks will be described in detail after the following block diagram overview.

The logic board is configured around two 8-bit latches, two 8-bit comparators, and a 16-bit counter which are used to generate a 16-bit BCD amplitude data word. The amplitude data can be entered by a 4-digit lever-switch or recalled from memory using the front-panel signal-selection push buttons. The amplitude data can be altered by the VARIABLE control, which increments or decrements the 16-bit counter by means of a voltage-controlled oscillator used as a clock for the counter. The analog output signal is generated from the 16-bit BCD amplitude data using a 16-bit digital-to-analog converter (DAC) and a 12-bit offset DAC. The 16-bit data also drives a front-panel LED display.

LOGIC DISPLAY ①

Signal Selection

PRESET and MANUAL are the VAC'S two primary modes of operation that generate the amplitude data used to form the reference square wave output. When the VAC is in the PRESET mode, amplitude data is generated by a 2K by 8 EPROM U444. Input information to U444, provided by the Preset Group and Preset Level buttons, is encoded from 8 lines to 3 lines by U456 and U458 respectively. The level selection (FULL AMP/REDUCED, SETUP, PRESET/MANUAL) and system select (NTSC, PAL, PAL M, SECAM) buttons provide TTL information directly to U444. In the MANUAL mode, addressing information is generated by front-panel Lever Switches only.

Because the DAC uses 16-bit data and the EPROM stores only 8-bit data, U444 is enabled at twice the rate (at the rate of $\overline{ME}$) of the information being loaded into the DAC (at the rate of Chop).The first 8-bits of address data out of U444 represent the tenths and units information shown on the readout, while the second 8-bits of address data represent the tens and hundreds. When the VAC is in the MANUAL mode, information is clocked from the Lever Switches in the same manner. P431 pins 6-9 and 1-4 (selected during $\overline{LLL}$ time) represent the tenths and units while P449 pins 6-9 and 1-4 represent the tens and hundreds (selected during $\overline{LHL}$ time). See Figure 3-1.

When the VAC is switched to the MANUAL mode, +5 V is applied to the Output Enable ($\overline{OE}$) pin 20 of U444, turning the memory off. It also applies +5 V to the emitters of Q428 and Q431. This enables the timing pulses $\overline{LLL}$ or $\overline{LHL}$ at the base of the transistors to drive the Lever Switches at P431 or P449 pins 5 and 10.

Amplitude Data Logic

Amplitude data from the memory or Lever Switches is loaded into the latches (U425 and U427) and then to the counters(U412, U414, U415, and U416). From the counters, the data is then sent to the readout display (on A2 Readout Board) and to the buffers (U404 and U406). How this amplitude data is clocked through these components is described in the following. To help in the description, a situation is presented where the amplitude data has just been changed.

When the memory (U444) or Lever Switch amplitude data is changed, the first byte (low byte) of data is presented to the low byte comparators (U423 and U442) and the low latch (U425) during $\overline{LLL}$. The asynchronous comparators (U423 and U442) will send a low to U454A (D input), indicating that there is a difference between the latch input and output. At the rising edge of $\overline{LLL}$, U453C pin 10 will send out a "load counter pulse" ($\overline{LC}$). This enables the data at the output of the latches (U425 and U427) to be loaded into the counters (U412 through U416). The second byte of data (high byte) is clocked through in the same manner. The high byte data is presented to the high latch (U427) during $\overline{LHL}$. The asynchronous comparators (U426 and U446) will send a low to U454B pin 4, indicating that there is a difference between the latch input and output. If the first byte (low byte) of data was the same and $\overline{LC}$ had not gone low, then U453C pin 10 will now send a "load counter pulse" ($\overline{LC}$') at the rising edge of $\overline{LHL}$. Otherwise, if the first byte of data was different, $\overline{LC}$ would still be in a low state. In that case, as soon as the high byte data was clocked into the latch at $\overline{LHL}$, it would also be loaded into the counters. A flow chart is provided in Fig. 3-2 to better illustrate the amplitude data flow in reference to the timing pulses.

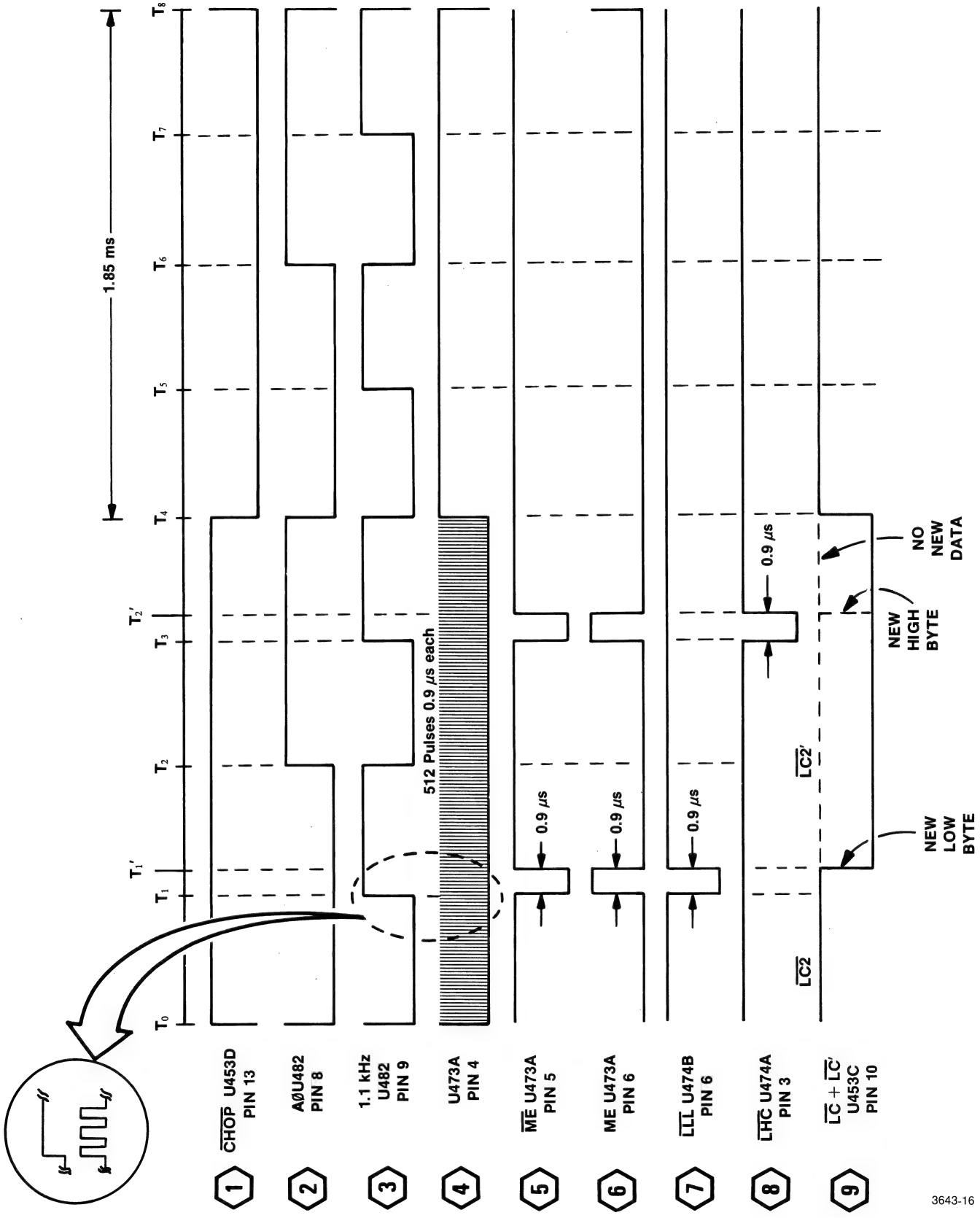


Fig. 3-1. Logic Clock.

@

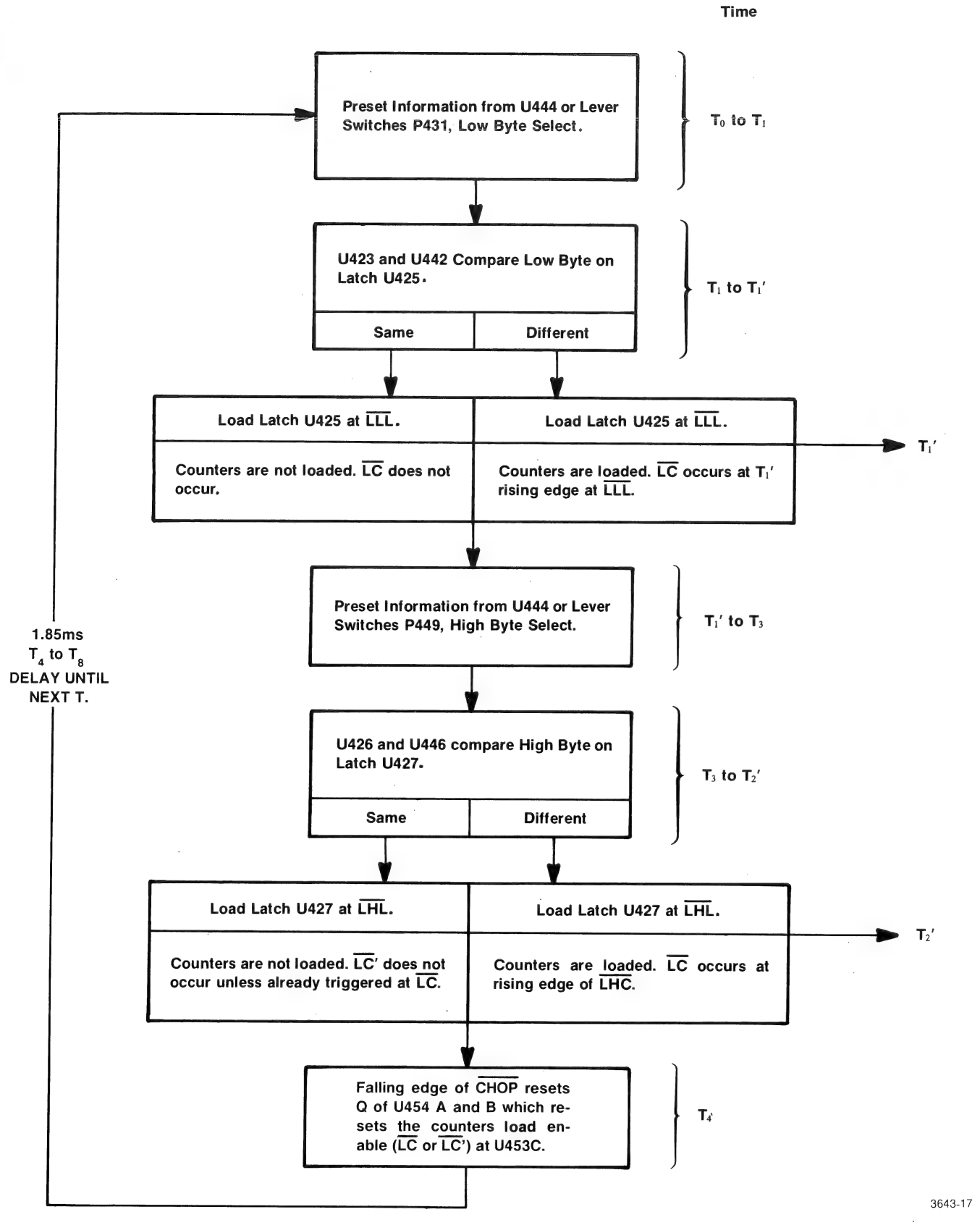


Fig. 3-2. Amplitude Data Clock.

Timebase

The time-base oscillator circuitry is referenced from one of two crystals, determined by which TV system button is selected. Q477 and Q497 form a switch system that allows TTL information from the Switch board A1 to select the crystal to be used. NTSC or PAL-M TV system button selections send a low to P444 pin 3, enabling Q477 and Y478. Conversely, PAL or SECAM TV system button selections send a high to P444 pin 3, enabling Q497 and Y488. Q474 is part of a Colpitts oscillator circuit, the output of which is shaped by Q475 and a buffer (U474C) before clocking the binary counter at U495 pin 14. For the sake of clarity, the counter timing block made up of U495, U494, U493, and U482 is illustrated in Fig. 3-3, showing the breakdown of the reference-oscillator frequency and final output of the VAC's timing pulses. Although two different crystals are used to run the oscillator circuit, the change in the final timing pulses is small. The only reason for the two crystals is to change the OUTPUT chop rate from 270 HZ for NTSC and PAL-M TV systems to 275 HZ for PAL and SECAM TV systems.

Variable Control

The VARIABLE control is used to vary the amplitude of the chopped OUTPUT independently from the Lever Switches or Preset select buttons. It does this by clocking the counters (U412, U414, U415, and U416) up and down. Normally, when the variable control is not used, the counters are operated as latches using the load function. The VARIABLE control uses a springloaded recentering mechanism to vary a 10 KΩ pot which supplies a plus or minus voltage to the bases of Q460, Q461, and to the plus input of U421. Q460 and Q461 form an absolute value amplifier and vary the voltage at the base of Q462 as the magnitude of voltage is changed by the VARIABLE control. Q462 in turn varies the current source which changes the frequency of the oscillator circuit made from U470. When the VARIABLE control is centered, Q462 is off and there are no clock pulses generated. However, when the VARIABLE control is turned in either direction, Q462 is turned on and helps to generate clock pulses at a frequency proportional to the amount of bias on the bases of Q460 and Q461. Clock pulses out of U470 pin 3 are used to clock the counters and to set flip-flop (U473B) to enable the VARIABLE indicator light (DS76). The positive or negative voltage applied to the comparator (U421) generates the down/up function for the addressing clocks. Turning the VARIABLE control counterclockwise results in a positive input and output from U421, enabling the down function of the clocks. Conversely, turning the VARIABLE control clockwise results in a negative input and output from U421, enabling the up function of the clocks.

Once the VARIABLE control has been used, the VAC may be reset to the original Lever Switch or preset selection value by pressing the RESET button. The RESET button applies a low to U454A and U454B clear inputs, which generates a new load pulse from U453C to the clocks. This loads in the original amplitude data from the latches (U425 and U427).

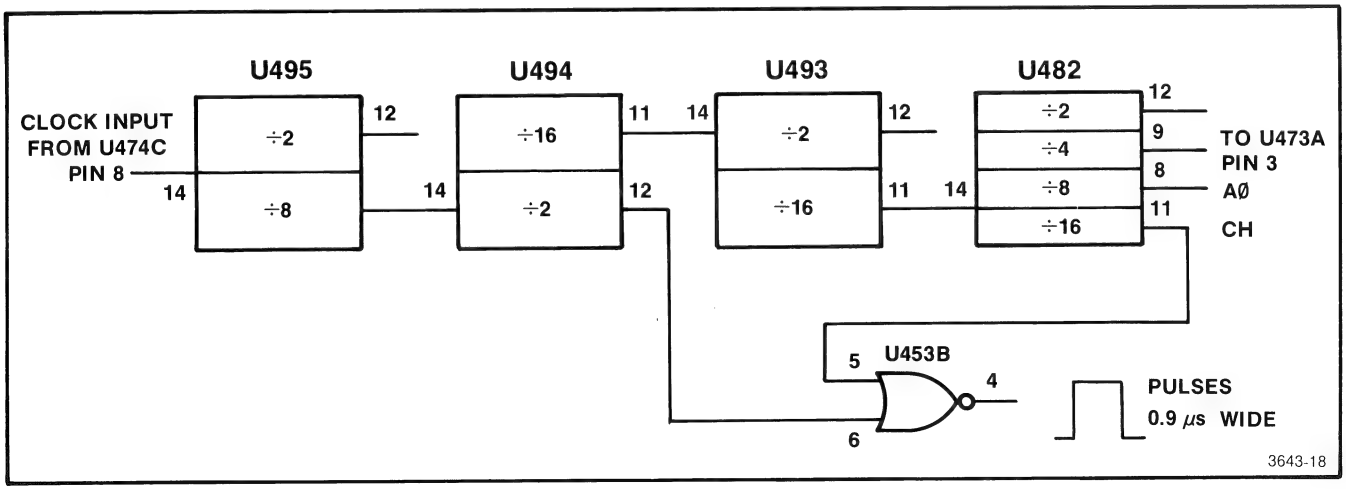


Fig. 3-3. Timebase breakdown.

DISPLAY AND DAC DIAGRAM ②

Amplitude Data Input and DAC Output

The 16 bits of amplitude data from the Logic Board A4 are brought into the DAC board at the edge connectors P365 and P360 pins 2-9. From the edge connectors, the amplitude data are sent to the octal buffers (U353 and U357) while the 12 most significant bits are sent directly to the Offset DAC (U348). The Chop pulse from the Logic board enters the DAC board at P365 and P360 pins 10 and is sent to the octal buffers through the Operate Mode jumper P359. Address information is then sent to the Signal DAC through the octal buffers when the Chop pulse is low. When the Chop pulse is high, amplitude data is not passed through to the Signal DAC, and the output of the octal buffers is pulled high by the pull-up resistor network of R351 and R355. Therefore, the 12 MSB of amplitude data are present at the input of the Offset DAC at all times while the 16 bits of address data are only present at the input of the Signal DAC when the Chop pulse is low.

Amplitude data sent to both DAC's are translated into specific amounts of current generated at their outputs. The amount of output current is determined by the bits enabled at the DAC inputs. Table 3-1 lists the amount of current generated by the individual bit inputs to each DAC. The current each DAC generates is then used to drive the plus and minus inputs of U335. The minus input of U335 is (driven by the Signal DAC output), turned on and off at the rate of Chop. The + input of U335 is used to set a reference for the relative amplitude values of the switched dc output. Depending on the Reference Offset mode selected, the + input of U335 is held at a reference ground (+LUM selected) or driven by the Offset DAC (CHR P-P or -SYNC selected). Changing the Reference Offset mode only changes the relative value of the switched dc output and not the p-p amplitude of the switched dc output. For example, if the VAC was setup for a 800.0 mV output in the -SYNC mode, the relative values of the output would be from -800.0 mV to 0 V. In the CHR P-P mode it would be from -400.0 mV to +400.0 mV and in the +LUM mode it would be from -800.0 mV to 0 V.

Table 3-1

DAC Output Current Capabilities

Bit Enabled (on = low)	DAC Current
15	1.0 mA
14	500 μA
13	250 μA
12	125 μA
11	62.5 μA
10	31.25 μA
9	15.625 μA
8	7.813 μA
7	3.906 μA
6	1.953 μA
5	0.997 μA
4	0.488 μA
3	0.244 μA
2	0.122 μA
1	0.061 μA
0	0.031 μA

Power Supply

The VAC uses the three unregulated supply sources from the power supply module (TM500-Series mainframe) to form three regulated voltage supplies. The unregulated supplies come in through the rear edge connector at -33.5, +33.5, and +11.5 V. The +11.5 V unregulated supply is used as a source for the voltage-follower transistors on the +5 V regulated supply. Both the +33.5 V and -33.5 V supplies are used as a source for the +15 V and -15 V regulated supplies. The +33.5 V and -33.5 V supplies are also shunt regulated by zener diodes VR378 and VR385 to produce the +20 V and -20 V supplies for the op-amps in all three regulated supplies. Also, the +20 V supply drives U368, which provides a precise 10 V source used as a reference for each op-amp in the regulator circuits.

The +15 V regulated supply contains an amplifier (U378) configured as a non-inverting amplifier with a voltage follower consisting of Q391 and Q392. The input signal to the op-amp is 5.99 V, which is divided down from the 10 V reference. The amplifier operates with a gain of 2.5, giving an output of 14.99 V. Q391 and Q392 provide current gain and unity-voltage gain at the output of the supply. CR378, CR379, and CR380 are used in conjunction with R378 to limit output current. The +5 V supply is similar to the +15 V supply except for having an input of 2.0 V to op-amp U371 instead of 5.99 V. The -15 V regulated supply also functions similarly, except that op-amp U375 is configured as a inverting amplifier with a gain of 1.5.

Readout

Amplitude Data from A4 Logic board provides BCD data to the 4-digit LED display. Normally, S36B on the TOLERANCE control is closed, so the flasher (U295) enables the display all the time. When the TOLERANCE control is enabled, S36B opens and the display flasher (U295) indicates the uncalibrated OUTPUT.

CALIBRATION PROCEDURE

PERFORMANCE CHECK PROCEDURE

Introduction

The Performance Check Procedure verifies the electrical performance requirements. It also includes a functional operation check which makes the procedure usable to determine the instrument's acceptability for an incoming inspection facility. If the Video Amplitude Calibration Fixture (VAC) fails the first step in the performance check, recalibration of the instrument is required. The Adjustment Procedure follows the Performance Check Procedure in this section. If recalibration does not correct the discrepancy, or if the instrument fails any of the other performance checks, repair is necessary.

Calibration Interval

To ensure instrument accuracy, calibration is recommended every 12 months.

Services Available

Tektronix, Inc. provides complete instrument repair and adjustment at local field Service Centers and at the Factory Service Center. Contact your local Tektronix Field Office or representative for further information.

Performance Documentation

Because the VAC will be used to provide an amplitude-calibration reference for many video sources and display devices, a special effort to document VAC performance is suggested. Appendix A provides fill-in tables for performance checks 1 and 3 and a Performance Check List which should be completed every time the VAC is calibrated to insure the instrument is NBS traceable. Copies of the performance documentation will be provided to the customer every time the VAC is calibrated by a Tektronix Service Center. The Service Centers will also be required to send a copy to Television Service Support in Beaverton for analysis.

Test Equipment Required

The following test equipment, or the equivalent, is suggested to perform the Performance Check and Adjustment Procedure.

Table 4-1

TEST EQUIPMENT REQUIRED

Description	Performance Requirements	Example
DC Voltmeter	Accuracy of 0.01% at 1 V. Must be NBS traceable.	Fluke 8500A Dana 6900A
Oscilloscope System	50 MHZ bandpass. 1 mV/div. 1 μs/div.	TEKTRONIX 7603 TEKTRONIX 7A13 TEKTRONIX 7B35A
Power Module		TEKTRONIX TM503
TM 500 Extender Cable		Tektronix part no. 067-0645-02
75 Low Loss Coaxial Cable		Tektronix part no. 012-0159-01 or 012-0159-00
Bnc to "EZ" Clip Adapter		Tektronix part no. 013-0076-01

Preliminary Procedure

1. Ensure that all test equipment is adapted to a suitable applied line-voltage source.

2. Install the VAC into the power module or connect it to the extender cable.

3. Turn on all equipment and allow at least 20 minutes for the VAC to stabilize. Refer to the DVM manual for its warm-up time.

PROCEDURE

1. Check Amplitude Range, Lever Switches

a. Turn the power to the VAC off and remove the instrument from its power module.

b. Remove the two screws holding the top cover on the VAC. Lift the cover off.

c. Move the Operate Mode jumper at P359 on the DAC board A3 to its (3-4) ON position.

d. Connect the VAC back to the power module and turn the power on.

e. Set the VAC front-panel controls as follows:

PRESET/MANUAL	Out	MANUAL
+LUM/−SYNC	In	+LUM
CHR P-P/LUM/SYNC	Out	LUM/SYNC
Lever Switches	000.0	

f. Connect the OUTPUT of the VAC through the 75 Ω low loss cable to the input of a dc voltmeter and leave hooked up through step 3. Verify that the reading on the voltmeter, minus the reference zero reading, is within the range given in the "Specification Tolerance" column in Table 4-2 adjacent to the Lever Switch Setting the VAC was set for.

Repeat this step for each Lever Switch Setting listed in Table 4-2.

2. Check TOLERANCE Control

a. Set the VAC front-panel controls as follows:

PRESET/MANUAL	Out	MANUAL
+LUM/−SYNC	In	+LUM
CHR P-P/LUM/SYNC	Out	LUM/SYNC
Lever Switches	111.1	

b. Pull the TOLERANCE control out and turn it fully counter-clockwise. The readout on the VAC should now be flashing.

Table 4-2

Amplitude Tolerance Check

Lever Switch Setting (mV)	Specification Tolerance ±(.05% + .1 mV)	Specification Tolerance with TOLERANCE Control Enabled −3% ±(.5% + .1 mV) +3%
000.0	Reference	Zero Reference
111.1	110.94 — 111.26	107.13 — 108.41 : 113.76 — 115.11
222.2	221.99 — 222.41	
333.3	333.03 — 333.57	
444.4	444.08 — 444.72	
555.5	555.12 — 555.88	536.04 — 541.63 : 569.20 — 575.13
666.6	666.17 — 667.03	
777.7	777.21 — 778.19	
888.8	888.26 — 889.34	
999.9	999.3 — 1000.50	964.95 — 974.85 : 1024.65 — 1035.15

Table 4-3

DIFFERENTIAL LINEARITY CHECK

Lever Switch Settings		Actual Readings from DVM		Differential Amplitude
V1	V2	a_{V1}	a_{V2}	$a_{V2} - a_{V1}$
000.0	000.1			
000.1	000.2			
000.3	000.4			
000.7	000.8			
000.9	001.0			
001.9	002.0			
003.9	004.0			
007.9	008.0			
009.9	010.0			
019.9	020.0			
039.9	040.0			
079.9	080.0			
099.9	100.0			
199.9	200.0			
399.9	400.0			
799.9	800.0			
999.9				

c. Using Table 4-2 verify that the reading on the voltmeter, minus the zero reference reading, is within the range given in the "TOLERANCE Control Enabled, −3%" column for the Lever Switch setting the VAC has been set for.

d. Turn the TOLERANCE control fully clockwise and repeat step c using the range given under the "+3%" column.

e. Repeat steps b, c, and e for a Lever Switch setting of 555.5 and 999.9. Press the TOLERANCE control back in.

NOTE

The reading on the DVM when measuring 000.0 is the reference zero reading. The reference zero reading is subtracted from the actual reading of the DVM when measuring the other Lever Switch settings listed in Table 4-2. The value of the reference zero reading is typically less than 1.0 mV.

3. Check Absolute and Differential Linearity

a. Set the VAC front-panel controls as follows:

PRESET/MANUAL	Out	MANUAL
+LUM/−SYNC	In	+LUM
CHR P-P/LUM/SYNC	Out	LUM/SYNC
Lever Switches	000.0	

b. Fill out Table 4-3 Differential Linearity Check. For each Lever Switch setting V1 and V2, log the actual reading in mV for a_{V1} and a_{V2} respectively.

c. Calculate the differential amplitude by using the equation a_{V2}-a_{V1}. The differential amplitude must be within ±.05 mV.

Table 4-4

ABSOLUTE LINEARITY

Lever Switch Setting ($V_{desired}$)	Actual Reading (mV) (V_{actual})	Absolute Linearity Error
250.0 mV		
500.0 mV		
750.0 mV		

e. Fill out Table 4-4 and calculate the absolute linearity error by the following equation. The absolute linearity must be less than ±0.1 mV.

$$V_{actual} - V_{offset} - \frac{V_{desired}}{999.9}(V_{fullscale} - V_{offset}) = \text{Absolute Linearity Error}$$

= Absolute Linearity Error

$V_{desired}$ — Lever Switch Setting at point which linearity is being measured.

V_{actual} — Measured voltage at point which linearity is being measured.

$V_{fullscale}$ — Measured voltage with Lever Switches set to 999.9.

V_{offset} — Measured voltage with Lever Switches set to 000.0.

$V_{fullscale}$ and V_{offset} values can be taken from Table 4-3 under the a_{V1} column adjacent to the proper Lever Switch Setting.

4. Check Preset Group, Preset Level, System Select, and Amplitude Setup Functions

The purpose of this check is to exercise each of the preset functions. Only a selected sample of combinations is made to check the operation of each button. This is because it would not be feasible to check the 500-plus combinations of preset values the VAC is capable of generating. Table 4-5 is an example of such a check where selected values were picked. This table, however, does not have to be followed. The only requirement is that each Preset Level and Preset Group button is exercised, and that the correct output in mV is indicated on the readout. A complete list of all the different Preset Level combinations is provided at the end of the Adjustment Procedure in this section.

a. Set the VAC front panel controls as follows:

PRESET/MANUAL	In	PRESET
+LUM/—SYNC	In	+LUM
CHR P-P/LUM/SYNC	Out	LUM/SYNC
Lever Switches	000.0	

b. Connect the OUTPUT of the VAC through the 75 Ω low-loss cable to the input of a dc voltmeter.

c. Use Table 4-5 to select the front-panel settings for the VAC, and verify that each readout is correct. Also, check all dc levels through the OUTPUT using the dc voltmeter.

d. Turn the power off to the VAC and remove it from the power module.

e. Place the jumper of P539 to its original 2—3 (OPERATE) position and replace the top cover to the VAC.

f. Replace the VAC into its power module and turn the power on.

Table 4-5

PRESET TEST SELECTIONS

CHECK #	NTSC	PAL	PAL-M	SECAM	CB CHR	CBQ	CBI	CB B-Y U D'R	CB R-Y V D'B	CBLUM	55-100	7.5-50	FULL AMP	REDUCED	SETUP	NO SETUP	PRESET LEVEL	READOUT
1	X				X								X		X		BK	000.0
2	X					X							X		X		BL	334.0
3	X						X						X		X		RD	641.8
4		X						X					X		X		MG	303.9
5		X							X				X		X		GN	540.5
6			X							X		X		X			CY	505.7
7			X								X		X		X		60	420.0
8				X								X	X		X		7.5	52.5

@

5. Check Noise

a. Set the VAC front-panel controls as follows:

PRESET/MANUAL	Out	MANUAL
CHR P-P/LUM/SYNC	In	CHR P-P
Lever Switches	000.0	

b. Connect the 75 Ω cable from the OUTPUT of the VAC to a dc coupled vertical input of an oscilloscope.

c. Set the vertical amplifier of the oscilloscope to 1 mV/div. The noise coming out of the VAC should not exceed 1 mV, from 0—5 MHZ.

6. +LUM, −SYNC, CHR P-P, VARIABLE, RESET

a. Set the VAC front-panel controls as follows:

PRESET/MANUAL	Out	MANUAL
CHR P-P/LUM/SYNC	In	CHR P-P
Lever Switches	555.5	

b. Connect the 75 Ω cable from the OUTPUT of the VAC to a dc-coupled vertical input of an oscilloscope.

c. Set the vertical amplifier at 200 mV/div and adjust the timebase so a few cycles of the square wave are showing.

d. Turn the VARIABLE control on the VAC clockwise and verify that both peaks of the square wave are moving away from ground at the same rate. The red LED below the VARIABLE control should turn on.

e. Reset the VAC back to 555.5 mV by pressing the RESET button. The red LED should now be off.

f. On the front panel of the VAC, reset the CHR P-P/LUM/SYNC and the +LUM/—SYNC buttons to the Out position. Turn the VARIABLE control fully counter- clockwise and verify that only the negative peak of the square wave moves away from ground. Reset the VAC back to 555.5 mV.

g. Set the +LUM/—SYNC to the in position. Turn the VARIABLE control fully clockwise and verify that only the positive peak on the square wave moves away from ground.

7. Check Rise Time

a. Set the VAC front-panel controls as follows:

PRESET/MANUAL	Out	MANUAL
Lever Switches	500.0	

b. Connect the OUTPUT from the VAC to a dc-coupled vertical input of an oscilloscope.

c. Set the vertical amplifier of the oscilloscope to 200 mV/div and adjust the horizontal to 0.5 ms/div. Turn the delay time on the horizontal to 1 μs/div and verify that the rise time is less than 1 μs.

8. Check OUTPUT Frequency

a. Set the VAC front-panel controls as follows:

PRESET/MANUAL	Out	MANUAL
NTSC	In	
Lever Switches	500.0	

b. Connect the OUTPUT from the VAC to a dc-coupled vertical input of an oscilloscope.

c. Set the vertical amplifier of the oscilloscope to 200 mV/div and adjust the horizontal for a + slope trigger at 0.2 ms/div. Verify that one half cycle of the square wave is approximately 1.85 ms.

d. Set the PAL button on the VAC to the 'in' position. Verify that one-half cycle of the square wave is approximately 1.82 ms.

e. An alternate procedure is to use a counter to check for a frequency of 270 Hz for NTSC and PAL-M standard selections or 275 Hz for PAL and SECAM standards at the OUTPUT of the VAC.

ADJUSTMENT PROCEDURE

Introduction

Use this adjustment procedure to restore the VAC to original performance requirements. This Adjustment Procedure need not be performed unless the instrument fails to meet the Performance Requirements of the electrical characteristics listed in the Specification section, or if the Performance Check Procedure cannot be completed satisfactorily. If the instrument has undergone repairs on the DAC board A3, the Adjustment Procedure is required.

Completion of all adjustment steps in this procedure does not check specifications for which there are no adjustments. Therefore, the Performance Check Procedure must be completed after the Adjustment Procedure.

Test Equipment Required

The test equipment (or equivalent) listed in Table 4-1 is required for adjustment of the VAC. Specifications given for the test equipment are the minimum necessary for accurate adjustment. All test equipment is assumed to be correctly calibrated and operating within specifications. The DVM used must be NBS traceable.

An optional piece of test equipment not mentioned in Table 4-1 is an oven which has to be capable of creating an artificial climate of +35°C. The oven is not needed if step 3 in the Calibration Procedure is not done.

Adjustment Locations

Refer to the adjustment locations pullout in this manual for location of all adjustable components and test points mentioned in this procedure. All adjustable components are located at the top towards the front panel of the VAC on A3 (DAC board).

Preliminary Procedure

1. Ensure that all test equipment is adapted to a suitable applied line-voltage source.

2. Connect the VAC through the TM 500 extender cable to the power module.

3. Turn on all equipment and allow at least 20 minutes for the equipment to stabilize. All adjustments must be made at an ambient temperature of 25°C ±3° to be NBS traceable.

PROCEDURE

1. Set R338 Offset, R349 +Gain, R339 −Gain

a. Turn the power to the VAC off and remove the instrument from its power source.

b. Remove the two screws holding the top cover to the VAC and lift the cover off.

c. Move the Operate Mode jumper at P359 to its 1—3 (OFF) position.

NOTE

If P335 is connected from pins 1 to 4 and 3 to 6, temperature compensation has been disabled and need not be adjusted unless found to exceed ±15 ppm/°C.

d. If an oven is available to perform optional step 3, pull jumper P335 (Temp Comp Polarity) off. Otherwise, leave jumper P335 in place.

e. Connect power to the VAC via the TM 500 extender cable and turn the power source back on.

f. Set the VAC front-panel controls as follows:

PRESET/MANUAL	Out	MANUAL
+LUM/−SYNC	In	+LUM
CHR P-P/LUM/SYNC	Out	LUM/SYNC
Lever Switches	000.0	

g. Connect the OUTPUT from the VAC through the 75 Ω low loss cable to the input of a dc voltmeter. Adjust R338 (Offset) for a reading of 0.0 mV.

@

h. Move the Operate Mode jumper P359 to its 3—4 (ON) position and reset the Lever Switches to 999.9. Adjust R349 (+Gain) for a reading of 999.9 mV.

i. Change the +LUM/−SYNC button on the front panel of the VAC to the 'out' position. Adjust R339 (−Gain) for a reading of 0.0 mV.

2. TOLERANCE Control Alignment

a. Set the VAC front-panel controls as follows:

PRESET/MANUAL	Out	MANUAL
+LUM/−SYNC	In	+LUM
CHR P-P/LUM/SYNC	Out	LUM/SYNC
Lever Switches	999.9	

b. Move the Operate Mode jumper P359 to its 3—4 (ON) position. Pull the TOLERANCE control out and rotate until 999.9 mV reads out on the voltmeter. Loosen the set screw on the TOLERANCE control and point the indicator to 0%. Tighten set screw.

c. With the TOLERANCE control still pulled out, turn it to +3% and adjust R329 (Tolerance) for an output of 1.0299 V. Turn the TOLERANCE control to −3% and adjust R329 for an output halfway between the reading measured and the desired reading of 969.9 mV (which should be in the range of 964.95 to 974.85 mV).

NOTE

Step 3 Temperature Compensation is optional and should not be done without an oven.

If P335 is connected from pins 1 to 4 and 3 to 6, temperature compensation has been disabled and need not be adjusted unless it is found to exceed ±15 ppm/°C.

Temperature Compensation (Optional Adjustment)

a. Set the front panel controls on the VAC as follows:

PRESET/MANUAL	Out	MANUAL
+LUM/−SYNC	In	+LUM
CHR P-P/LUM/SYNC	Out	LUM/SYNC
Lever Switches	999.9	

b. Connect a bnc-to-"EZ" clip adapter to the 75 Ω low-loss cable. Connect the "EZ" clip to TP336, and the other end of the cable to a dc voltmeter.

c. Replace jumper P335 (Temp Comp Polarity). Move jumper P359 to the 3—4 (ON) position. At room temperature, adjust R346 (TC AMPL) for a reading of 0.0 mV.

d. Use a large oven to heat the VAC to 35°C. Connect the dc voltmeter to the OUTPUT of the VAC. Adjust R336 (TC ZERO) for 999.9 mV.

e. If the temperature compensating circuit does not calibrate, rotate P335 180° and readjust R336 as above.

f. Recheck step 1, Offset, +Gain, −Gain.

4. Operation and Performance Verification

To assure the VAC is operating properly and all specifications are met, the Performance Check Procedure must follow the Adjustment Procedure.

Preset Levels

The following is a complete list of tables for all the different combinations of preset levels the VAC is capable of producing. The lists are separated into groups containing the preset levels for each video standard (NTSC, PAL, PAL M, and SECAM).

CONTENTS

Table 4-6

PRESET LEVELS

Level	NTSC	PAL	PAL M	SECAM
7.5	053.6	052.5	052.5	052.5
10	071.4	070.0	070.0	070.0
20	142.9	140.0	140.0	140.0
30	214.3	210.0	210.0	210.0
30.3[a]	216.5	212.1	212.1	212.1
40	285.7	280.0	280.0	280.0
42.9[a]	306.1	300.0	300.0	300.0
50	357.1	350.0	350.0	350.0
LEVEL	**NTSC**	**PAL**	**PAL M**	**SECAM**
55	392.9	385.0	385.0	385.0
60	428.6	420.0	420.0	420.0
70	500.0	490.0	490.0	490.0
75	535.7	525.0	525.0	525.0
77[a]	549.1	538.1	538.1	538.1
80	571.4	560.0	560.0	560.0
90	642.9	630.0	630.0	630.0
100	714.3	700.0	700.0	700.0

[a] **30.30 is actually 30.304;**
42.9 is actually 42.857;
77 is actually 76.875

Table 4-7

NTSC COLOR BARS PRESET LEVELS

FULL AMP (100%) and no SETUP

BAR	LUM	R−Y (P-P)	B−Y (P-P)	CHR (P-P)	I	Q
WH	714.3	000.0	000.0	000.0	000.0	000.0
YEL	635.7	142.6	624.2	640.3	459.6	445.9
CY	500.0	883.4	210.9	908.2	855.7	304.3
GN	421.4	740.8	413.4	848.3	396.1	750.1
MG	292.9	740.8	413.4	848.3	396.1	750.1
RD	214.3	883.4	210.9	908.2	855.7	304.3
BU	078.6	142.6	624.2	640.3	459.6	445.9
BK	000.0	000.0	000.0	000.0	000.0	000.0

FULL AMP (100%) and 7.5% SETUP

BAR	LUM	R−Y (P-P)	B−Y (P-P)	CHR (P-P)	I	Q
WH	714.3	000.0	000.0	000.0	000.0	000.0
YEL	641.6	131.9	577.4	592.3	454.7	441.2
CY	516.1	817.1	195.0	840.1	846.7	301.1
GN	443.4	685.2	382.4	784.7	392.0	742.3
MG	324.5	685.2	382.4	784.7	392.0	742.3
RD	251.8	817.1	195.0	840.1	846.7	301.1
BU	126.3	131.9	577.4	592.3	454.7	441.2
BK	53.6	000.0	000.0	000.0	000.0	000.0

REDUCED AMP (75%) and no SETUP

BAR	LUM	R-Y (P-P)	B-Y (P-P)	CHR (P-P)	I	Q
WH	535.7	000.0	000.0	000.0	000.0	000.0
YEL	476.8	106.9	468.2	480.2	344.7	334.4
CY	375.0	662.5	158.1	681.2	641.8	228.2
GN	316.1	555.6	310.0	636.2	297.1	562.6
MG	219.6	555.6	310.0	636.2	297.1	562.6
RD	160.7	662.5	158.1	681.2	641.8	228.2
BU	058.9	106.9	468.2	480.2	344.7	334.4
BK	000.0	000.0	000.0	000.0	000.0	000.0

REDUCED AMP (75%) and 7.5% SETUP

BAR	LUM	R-Y (P-P)	B-Y (P-P)	CHR (P-P)	I	Q
WH	549.1	000.0	000.0	000.0	000.0	000.0
YEL	494.6	098.9	433.1	444.2	339.9	329.7
CY	400.4	612.9	146.3	630.1	632.8	225.0
GN	345.9	513.9	286.8	588.5	292.9	554.7
MG	256.7	513.9	286.8	588.5	292.9	554.7
RD	202.2	612.9	146.3	630.1	632.8	225.0
BU	108.1	098.9	433.1	444.2	339.9	329.7
BK	053.6	000.0	000.0	000.0	000.0	000.0

X1.2
=105.86 IRE
(756.12 mV)

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Table 4-8

PAL COLOR BARS PRESET LEVELS

FULL AMP (100%) and no SETUP

BAR	LUM	V	U	CHR(P-P)
WH	700.0	000.0	000.0	000.0
YEL	620.2	140.0	611.5	627.3
CY	490.7	860.7	206.4	885.1
GN	410.9	720.7	405.1	826.8
MG	289.1	720.7	405.1	826.8
RD	209.3	860.7	206.4	885.1
BU	079.8	140.0	611.5	627.3
BK	000.0	000.0	000.0	000.0

FULL AMP (100%) and 25% SETUP

BAR	LUM	V	U	CHR(P-P)
WH	700.0	000.0	000.0	000.0
YEL	640.2	105.0	458.6	470.5
CY	543.0	645.5	154.8	663.8
GN	483.2	540.5	303.9	620.1
MG	391.8	540.5	303.9	620.1
RD	332.0	645.5	154.8	663.8
BU	234.9	105.0	458.6	470.5
BK	175.0	000.0	000.0	000.0

REDUCED AMP (75%) and no SETUP

BAR	LUM	V	U	CHR(P-P)
WH	525.0	000.0	000.0	000.0
YEL	465.2	105.0	458.6	470.5
CY	368.0	645.5	154.8	663.8
GN	308.2	540.5	303.9	620.1
MG	216.8	540.5	303.9	620.1
RD	157.0	645.5	154.8	663.8
BU	059.9	105.0	458.6	470.5
BK	000.0	000.0	000.0	000.0

Table 4-9

PAL M COLOR BARS PRESET LEVELS

FULL AMP (100%) and no SETUP

BAR	LUM	V	U	CHR(P-P)
WH	700.0	000.0	000.0	000.0
YEL	620.2	140.0	611.5	627.3
CY	490.7	860.7	206.4	885.1
GN	410.9	720.7	405.1	826.8
MG	289.1	720.7	405.1	826.8
RD	209.3	860.7	206.4	885.1
BU	079.8	140.0	611.5	627.3
BK	000.0	000.0	000.0	000.0

FULL AMP (100%) and 50 mV SETUP

BAR	LUM	V	U	CHR(P-P)
WH	700.0	000.0	000.0	000.0
YEL	625.9	130.0	567.8	582.5
CY	505.7	799.2	191.6	821.9
GN	431.6	669.2	376.2	767.7
MG	318.5	669.2	376.2	767.7
RD	244.4	799.2	191.6	821.9
BU	124.1	130.0	567.8	582.5
BK	050.0	000.0	000.0	000.0

REDUCED AMP (100%) and no setup

BAR	LUM	V	U	CHR(P-P)
WH	525.0	000.0	000.0	000.0
YEL	465.2	105.0	458.6	470.5
CY	368.0	645.5	154.8	663.8
GN	308.2	540.5	303.9	620.1
MG	216.8	540.5	303.9	620.1
RD	157.0	645.5	154.8	663.8
BU	059.9	105.0	458.6	470.5
BK	000.0	000.0	000.0	000.0

REDUCED AMP (75%) and 50 mV SETUP

BAR	LUM	V	U	CHR(P-P)
WH	537.5	000.0	000.0	000.0
YEL	481.9	097.5	425.9	436.9
CY	391.7	599.4	143.7	616.4
GN	336.2	501.9	282.2	575.8
MG	251.3	501.9	282.2	575.8
RD	195.8	599.4	143.7	616.4
BU	105.6	097.5	425.9	436.9
BK	050.0	000.0	000.0	000.0

Table 4-10

SECAM COLOR BARS PRESET LEVELS

FULL AMP (100%) and no SETUP

BAR	+LUM	D'R	D'B
WH	700.0	214.5	166.7
YEL	620.2	175.9	449.2
CY	490.7	542.5	179.9
GN	410.9	507.2	333.5
MG	289.1	284.4	253.4
RD	209.3	348.6	233.7
BU	079.8	265.7	350.3
BK	000.0	214.5	166.7

REDUCED AMP (75%) and no SETUP

BAR	+LUM	D'R	D'B
WH	525.0	214.5	166.7
YEL	465.2	183.8	362.8
CY	368.0	476.0	168.5
GN	308.2	431.9	280.3
MG	216.8	212.3	211.6
RD	157.0	252.2	211.8
BU	059.9	252.2	277.5
BK	000.0	214.5	166.7

REDUCED AMP (25%) and (0%) SETUP

BAR	+LUM	D'R	D'B
WH	175.0	214.5	166.7
YEL	155.1	203.3	211.1
CY	122.7	295.8	161.5
GN	102.7	281.7	192.2
MG	072.3	168.7	162.0
RD	052.3	164.2	177.5
BU	020.0	226.6	168.2
BK	000.0	214.5	166.7

MAINTENANCE

PREVENTIVE MAINTENANCE

Preventive maintenance steps performed on a regular basis will improve the reliability of the VAC. However, checks of the semiconductors in the absence of a malfunction are not recommended as preventive maintenance measures. The recommended time for performing preventive maintenance is just before instrument adjustment.

Cleaning

CAUTION

Do not use acetone, MEK, MIBK, benzene, toluene, carbon tetracholoride, trichloroethylene, methyl alcohol, methylene chloride, sulphuric acid, or Freon compunds for cleaning the VAC. Use only clean water and a mild detergent.

Exterior. Loose dust may be removed with a soft cloth or dry brush. Water and a mild detergent may be used; however, abrasive cleaners should never be used.

Interior. Cleaning the interior of the unit should precede adjustment, since the cleaning process could alter the settings of calibration adjustments. Use low-velocity compressed air to blow off accumulated dust. Hardened dirt can be removed with a soft dry brush, cotton-tipped swab, or a cloth dampened in a solution of water and mild detergent.

Lubrication

Push-button switches on the Switch board A1 and the DAC board A3 should receive occasional spray applications of "No Noise" lubricant and cleaner to the gold areas of the switch and circuit board.

Adjustment

After cleaning or repairs, do the performance check as described in Section 4 of this manual. If all functions are within specification, no adjustment is needed. If one or more of the specifications are not met, calibrate the instrument as directed in Section 4.

TROUBLESHOOTING AIDS

Theory of Operation

Section 3 of this manual explains circuit operation in detail. The section is a troubleshooting aid when used in conjunction with the circuit diagrams.

Diagrams

A block diagram and detailed circuit diagrams are located on foldout pages in the Diagram section. The circuit diagrams show the component values and assigned circuit reference numbers of each component. The first page of the Diagram section defines the circuit symbols and reference designators used in the manual. Important waveforms and voltages are shown within the diagrams.

Circuit Board Illustrations

To identify electrical components when troubleshooting, turn to the Parts Location Grid that is located on the back of a foldout page at the left ot the related circuit diagrams. The parts location diagrams on the DAC board A3 and the Logic board A4 were drawn as if viewing the parts through the back of each board. Component values, descriptions, and ordering data are given in the Replaceable Electrical Parts list.

Component and Wiring Color Codes

Colored stripes or dots on electrical components signify electical values, tolerances, etc., according to EIA standards. Components not color coded usually have information printed on the body. Some wiring coding follows the same EIA standards.

Testing Equipment

Generally, a wide-band oscilloscope, a low-loss cable, and a precision DVM are all that is needed to perform basic waveform and voltage checks for diagnostic purposes. The Performance Check Procedure lists specific test equipment necessary to adequately check out the instrument.

TROUBLESHOOTING TECHNIQUES

This troubleshooting procedure is arranged in an order that checks the simple trouble possibilities before proceeding to extensive troubleshooting.

Control Settings

Incorrect control settings can appear to be an equipment problem. If there is any question about the correct function or operation of any control, see the operation instructions in Section 2.

If the VAC is operating as part of an interconnected system or test setup, also check control settings of the other instruments in the setup. Check for proper interconnections between the power module and the plug-in module. Check that the signal is properly connected and that the interconnecting cables and signal source are not defective. Check the power source.

If the power module is suspected, try substituting another VAC known to be good into the power module. If the trouble persists after substitution, move the VAC to other compartments in the power module to determine if the trouble is confined to one compartment or is common to all of them.

Visual Check

Remove the covers from the VAC and look for broken wires, loose or unsoldered connections, or damage to the circuit boards. If components damaged from overheating are found, determine the cause of overheating before replacing the component; otherwise, the new component may also be damaged.

Static-Sensitive Components

CAUTION

Static discharge can damage any semiconductor component in this instrument.

This instrument contains electrical components that are susceptible to damage from static discharge. See Table 5-1 for relative susceptibility of various classes of semiconductors. Static voltages of 1 kV to 30 kV are common in unprotected environments.

Observe the following precautions to avoid damage:

1. Minimize handling of static-sensitive components.

2. Transport and store static-sensitive components or assemblies in their original containers, on a metal rail, or on conductive foam. Label any package that contains static-sensitive assemblies or components.

3. Discharge the static voltage from your body by wearing a grounded wrist strap while handling these components. Servicing static-sensitive assemblies or components should be performed only at a static-free work station by qualified service personnel.

4. Nothing capable of generating or holding a static charge should be allowed on the work station surface.

5. Keep the component leads shorted together whenever possible.

6. Pick up components by the body, never by the leads.

7. Do not slide the components over any surface.

Table 5-1

RELATIVE SUSCEPTIBILITY TO STATIC DISCHARGE DAMAGE

Semiconductor Classes	Relative Susceptibility Levels[a]
Microcircuits with MOS inputs (most sensitive)	1
Schottky TTL	2
High-frequency bipolar transistors	3
Linear microcircuits	4
Low-power Schottky TTL	5
TTL (least sensitive)	6

[a] **Voltage equivalent for levels:**

1 = 100 to 500 V
2 = 500 V
3 = 400 to 500 V
4 = 400 to 1000 V (est.)
5 = 900 V
6 = 1200 V

(Voltage discharged from a 100 pF capacitor through a resistance of 100 Ω.)

8. Avoid handling components in areas that have a floor or work surface covering capable of generating a static charge.

9. Use a soldering iron that is connected to earth ground.

10. Use only special antistatic suction-type or wick-type desoldering tool.

Test Equipment

Before using any test equipment to make measurements on static-sensitive components or assemblies, be certain that any voltage or current supplied by the test equipment does not exceed the limits of the component to be tested.

Circuit Isolation

Note the symptom. It often identifies the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check the affected circuits by making waveform and voltage measurements.

Incorrect operation of all circuits often means trouble in power supplies. Using a multimeter, check first for correct voltages of the individual regulated supplies according to the circuit diagrams and adjustment procedures. Then check the unregulated supplies of the power modules. Defective components elsewhere in the instrument can appear as power supply problems. In these instances, suspected circuits should be disconnected from apparently bad power supplies one at a time to narrow the search.

Voltages and Waveforms

Often defective components can be located by using waveform and voltage indications when they appear on the circuit diagram and in the theory of operation sections. Such waveforms and voltage labels are typical indications and will vary between instruments.

Component Checking

If a component cannot be disconnected from its circuit, the effects of the associated circuitry must be considered when evaluating the measurement. Except for soldered-in transistors and integrated circuits, most components can be unsoldered and lifted at one end from the circuit board.

Transistors and Integrated Circuits (IC)

Turn the power switch off before removing or replacing any semiconductor. See Fig. 5-1 for semiconductor basing.

A good check of transistor operation is actual performance under operating conditions. A transistor can most effectively be checked by substituting a new component for it (or one which has been checked previously). However, be sure that circuit conditions are not such that a replacement transistor might also be damaged. If substitute transistors are not available, use a dynamic tester. Static-type testers are not recommended since they do not check operation under simulated operating conditions. An antistatic suction-type desoldering tool can be used to remove soldered-in transistors; see component replacement procedure for details.

Integrated circuits can be checked with a voltmeter, test oscilloscope, or by direct substitution. A good understanding of the circuit description is essential to troubleshooting circuits containing integrated circuits. Operating waveforms, logic levels, and other operating information for the integrated circuits are given in the circuit description information. Use care when checking voltages and waveforms around the integrated circuits so that adjacent leads are not shorted together. A convenient means of clipping a test probe to the 14- and 16-pin in-line integrated circuits is with an integrated circuit test clip.

Replacement semiconductors should be of the original type or a direct replacement. Figure 5-1 shows the lead configuration of the semiconductors used in this instrument system.

An extracting tool should be used to remove the 14- and 16-pin integrated circuits to prevent damage to the pins. This tool is available from Textronix, Inc. See Maintenance Aids. If an extracting tool is not available, use care to avoid damaging the pins. Pull slowly and evenly on both ends of the integrated circuit. Try to avoid having one end of the integrated circuit disengage from the socket before the other end.

Diodes

Ordinary signal diodes may be checked for an open or shorted condition by measuring the resistance between the terminals. With the ohmmeter set to the R X1000 scale, the resistance should be very high in one direction and very low when the leads are reversed.

Resistors

Check resistors with an ohmmeter. Resistor tolerances are given the Replaceable Electrical Parts list. Resistors do not normally to be replaced unless the measured value varies widely from the value.

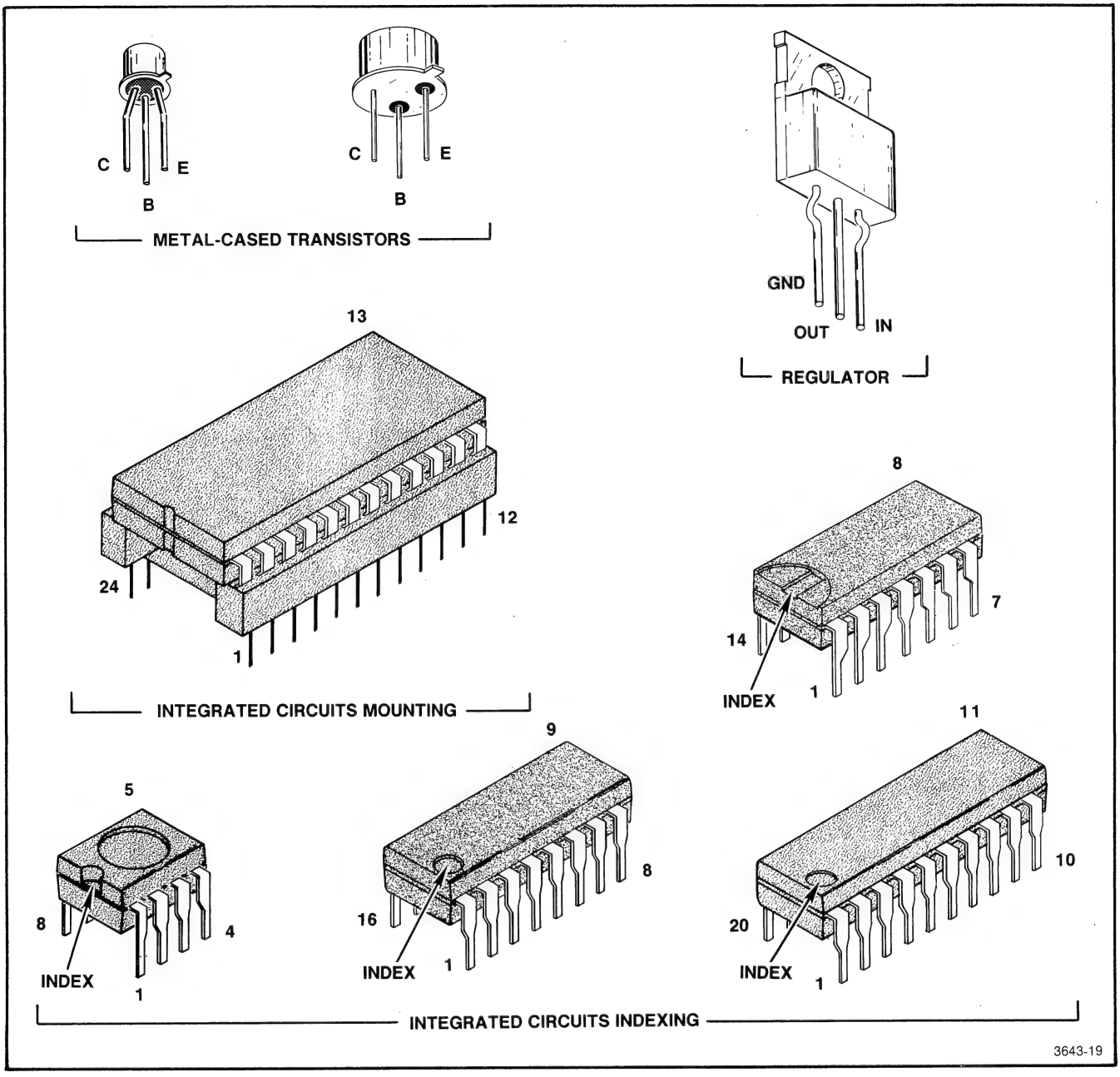


Fig. 5-1. Semiconductor Basing.

Circuit Board Removal

NOTE

Tag or note the locations of all leads and plugs for reassembly reference.

For easier access to the two main boards of the VAC (A3 and A4) the Logic board A4 may be removed and laid flat with respect to the bottom of the instrument (illustrated in Fig. 5-2). This also makes removal of most components possible without having to completely remove either of the main boards.

To remove the Logic board A4 (left side of instrument) completely, or for troubleshooting purposes to the position described above, follow these steps.

REMOVE:

1. The two side covers; grasp the cover at the rear of the VAC and pull away from the chassis.

2. The top and bottom covers; there are two screws holding each of the covers.

3. The back panel; four screws and two locating posts hold the back panel.

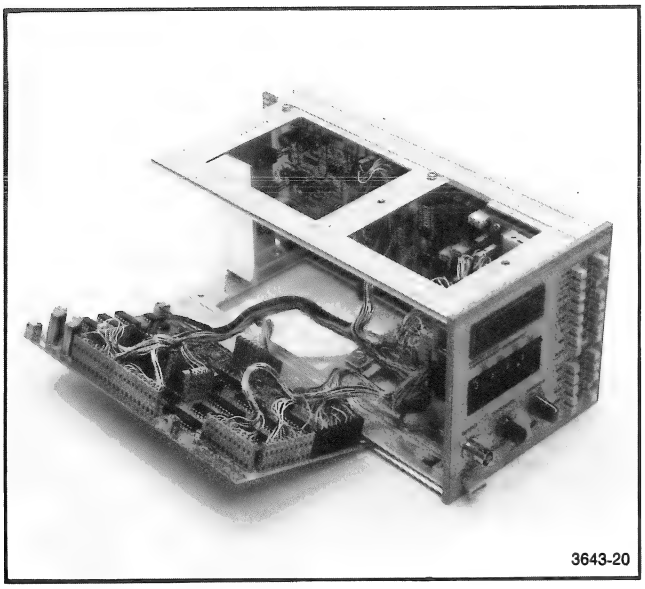


Fig. 5-2. A4 Logic Board position for troubleshooting.

4. The Logic board; four screws hold the logic board to the nut blocks and top and bottom extrusions. Remove the screws from the left side of the Logic board, leaving the nut blocks. Two each are located on the top and bottom of the VAC's chassis. Pry the top and bottom of the chassis away from each other near the Logic board and slip either the top or bottom of the board out of its groove. The Logic board is now free to either be slipped into the side cover groove for troubleshooting or completely removed by disconnecting all of the interconnecting cables.

To remove the DAC board A3, continue with the following steps.

REMOVE:

1. Heatsink screws; located on the bottom at the rear of the VAC.

2. All interconnecting cables to the board.

3. Board retaining screws; four screws hold the board in place. Two each are located at the top and at the bottom of the VAC chassis. The nut blocks should be left attached to the circuit board.

4. The DAC board A3; by pulling straight back, the board will slide out of the chassis.

PARTS ORDERING AND REPLACING

Ordering

Standard Parts. All electrical and mechanical replacement parts can be obtained through the local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally. Before purchasing or ordering replacement parts, check the Replaceable Parts lists for value, tolerance, rating, and description. When selecting replacement parts, it is important to remember that the physical size and shape of the component may affect its performance in an instrument. All replacement parts should be direct replacements unless it is known that a different component will not adversely affect the instrument performance.

Special Parts. Some parts are manufactured or selected by Tektronix, Inc., to satisfy particular requirements, or are manufactured for Tektronix, Inc.to our specifications. Most of the mechanical parts used in this system have been manufactured by Tektronix, Inc. Order all special parts directly from the local Tektronix Field Office or representative.

Ordering Procedure. When ordering replacement parts from Tektronix, Inc. please include the following minimum information:

1. Instrument type (067-0916-00 Variable Amplitude Calibration Fixture).

2. Instrument serial number (for example, B010165).

3. A description of the part (if electrical, include the circuit number).

4. Tektronix part number.

Please do not return any instruments or parts before receiving directions from Tektronix, Inc.

A listing of Tektronix Field Offices, Service Centers, and Representatives can be found in the Tektronix Products catalog and supplements.

CUSTOMIZING

Customizing the Interface

Input and output access to the VAC is available at the rear of the DAC board A3. Figure 5-3 identifies the contacts and their respective I/O assignments.

USING THE REAR INTERFACE CONNECTORS (See Figure 5-3)

Output

This terminal is connected directly from the output amplifier (U335) to the rear edge output connector pin 28A with pin 27A used as signal ground. Unlike the front-panel OUTPUT which has an output impedance of 37.5 Ω, the rear-panel output has an output impedance of 0 Ω.

Remote Operate

The switched dc rate of the output may be remotely controlled through this terminal for special applications that require a controlled or different rate of switched dc output. The Operate Mode jumper P359 must be moved to its 3-5 position which disables the VAC's internal Chop signal and connects the Remote Operate terminal through a 100 Ω resistor to the buffer enable inputs of U453 and U457. A 'low' will enable the buffers to pass addressing information to the 16-bit DAC (U345) which provides the OUTPUT reference level. A 'high' will not enable the buffers to pass the amplitude data to the 16-bit DAC, therefore leaving the OUTPUT at a low reference state. Pin 24B is the signal input with pin 25B used as signal ground.

REAR INTERFACE CONNECTOR ASSIGNMENTS

DAC BOARD A3

B	PIN #	A
NC	1	NC
+11.5 Vdc Fuse-protected	2	+11.5 Vdc Fuse-protected[a]
Power Supply Ground	3	Power Supply Ground
Power Supply Ground	4	Power Supply Ground
NC	5	NC
NC	6	NC
NC	7	NC
-33.5 Vdc Fuse-protected	8	-33.5 Vdc Fuse-protected[b]
Power Supply Ground	9	Power Supply Ground
NC	10	NC
NC	11	NC
+33.5 Vdc Fuse-protected	12	+33.5 Vdc Fuse-protected[b]
NC	13	NC
NC	14	NC
NC	15	NC
NC	16	NC
NC	17	NC
NC	18	NC
NC	19	NC
NC	20	NC
NC	21	NC
NC	22	NC
NC	23	NC
Remote Chop Control	24	NC
Remote Chop Ground	25	NC
NC	26	NC
NC	27	Signal Output Ground
NC	28	Signal Output

[a]Uses 2A Fast-blow

[b]Uses 0.4A Fast-blow

Fig. 5-3. Rear Interface Connector Assignments.

Table 5-2

MAINTENANCE AIDS

The following maintenance aids include items required for some maintenance procedures in this instrument.

Description	Specifications	Use
1. Soldering Iron	15 Watt	General soldering and unsoldering.
2. Screwdrivers	Phillips #1 tip Phillips #2 tip	Assembly and disassembly.
3. Nutdrivers	3/16″, 3/8″	General
4. Open-End Wrench	3/16″, 1/4″, 7/16″	General
5. Solder Wick		Unsoldering
6. Spray Cleaner	No Noise	All push button switches.
7. Vacuum Desoldering Tool	Antistatic	General
8. I.C. Extracting Tool		General

OPTIONS

These are no options for the 067-0916-00 Variable Amplitude Calibration Fixture at the time of this printing.

REPLACEABLE ELECTRICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

ACTR	ACTUATOR	PLSTC	PLASTIC
ASSY	ASSEMBLY	QTZ	QUARTZ
CAP	CAPACITOR	RECP	RECEPTACLE
CER	CERAMIC	RES	RESISTOR
CKT	CIRCUIT	RF	RADIO FREQUENCY
COMP	COMPOSITION	SEL	SELECTED
CONN	CONNECTOR	SEMICOND	SEMICONDUCTOR
ELCTLT	ELECTROLYTIC	SENS	SENSITIVE
ELEC	ELECTRICAL	VAR	VARIABLE
INCAND	INCANDESCENT	WW	WIREWOUND
LED	LIGHT EMITTING DIODE	XFMR	TRANSFORMER
NONWIR	NON WIREWOUND	XTAL	CRYSTAL

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

Mfr. Code	Manufacturer	Address	City, State, Zip
00853	SANGAMO ELECTRIC CO., S. CAROLINA DIV.	P O BOX 128	PICKENS, SC 29671
01121	ALLEN-BRADLEY COMPANY	1201 2ND STREET SOUTH	MILWAUKEE, WI 53204
01295	TEXAS INSTRUMENTS, INC., SEMICONDUCTOR GROUP	P O BOX 5012, 13500 N CENTRAL EXPRESSWAY	DALLAS, TX 75222
02111	SPECTROL ELECTRONICS CORPORATION	17070 EAST GALE AVENUE	CITY OF INDUSTRY, CA 91745
02735	RCA CORPORATION, SOLID STATE DIVISION	ROUTE 202	SOMERVILLE, NY 08876
04713	MOTOROLA, INC., SEMICONDUCTOR PROD. DIV.	5005 E MCDOWELL RD,PO BOX 20923	PHOENIX, AZ 85036
07263	FAIRCHILD SEMICONDUCTOR, A DIV. OF FAIRCHILD CAMERA AND INSTRUMENT CORP.	464 ELLIS STREET	MOUNTAIN VIEW, CA 94042
13919	BURR-BROWN RESEARCH CORPORATION	PO BOX 11400,6730 S TUCSON BLVD.	TUCSON, AZ 85706
15454	RODAN INDUSTRIES, INC.	2905 BLUE STAR ST.	ANAHEIM, CA 92806
18324	SIGNETICS CORP.	811 E. ARQUES	SUNNYVALE, CA 94086
24355	ANALOG DEVICES INC.	RT 1 INDUSTRIAL PK,P O BOX 280	NORWOOD, MA 02062
24546	CORNING GLASS WORKS, ELECTRONIC COMPONENTS DIVISION	550 HIGH STREET	BRADFORD, PA 16701
27014	NATIONAL SEMICONDUCTOR CORP.	2900 SEMICONDUCTOR DR.	SANTA CLARA, CA 95051
33096	COLORADO CRYSTAL CORPORATION	2303 W 8TH STREET	LOVELAND, CO 80537
55210	GETTIG ENG. AND MFG. COMPANY	PO BOX 85, OFF ROUTE 45	SPRING MILLS, PA 16875
56289	SPRAGUE ELECTRIC CO.	87 MARSHALL ST.	NORTH ADAMS, MA 01247
71590	CENTRALAB ELECTRONICS, DIV. OF GLOBE-UNION, INC.	P O BOX 858	FORT DODGE, IA 50501
72619	DIALIGHT, DIV. AMPEREX ELECTRONIC	203 HARRISON PLACE	BROOKLYN, NY 11237
72982	ERIE TECHNOLOGICAL PRODUCTS, INC.	644 W. 12TH ST.	ERIE, PA 16512
73138	BECKMAN INSTRUMENTS, INC., HELIPOT DIV.	2500 HARBOR BLVD.	FULLERTON, CA 92634
75042	TRW ELECTRONIC COMPONENTS, IRC FIXED RESISTORS, PHILADELPHIA DIVISION	401 N. BROAD ST.	PHILADELPHIA, PA 19108
75915	LITTELFUSE, INC.	800 E. NORTHWEST HWY	DES PLAINES, IL 60016
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
91637	DALE ELECTRONICS, INC.	P. O. BOX 609	COLUMBUS, NE 68601

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				ASSEMBLIES		
A1	670-6658-00			CKT BOARD ASSY:SWITCH	80009	670-6658-00
A2	670-6659-00			CKT BOARD ASSY:DISPLAY	80009	670-6659-00
A3	672-0983-00			CKT BOARD ASSY:DAC	80009	672-0983-00
A4	670-6660-00			CKT BOARD ASSY:LOGIC	80009	670-6660-00
				A1 SWITCH		
A1	670-6658-00			CKT BOARD ASSY:SWITCH	80009	670-6658-00
A1S112	263-0080-00			SWITCH,PB ASSY:4 LATCH,7.5MM,10 CONT	80009	263-0080-00
A1S116	263-0079-00			SWITCH,PB ASSY:8 LATCH,7.5MM,16 CONT	80009	263-0079-00
				A2 DISPLAY		
A2	670-6659-00			CKT BOARD ASSY:DISPLAY	80009	670-6659-00
A2C215	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
A2C216	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A2C285	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
A2C292	283-0026-00			CAP.,FXD,CER DI:0.2UF,+80-20%,25V	56289	274C3
A2DS215	150-1013-00			LAMP,LED:READOUT	01295	TIL311
A2DS235	150-1013-00			LAMP,LED:READOUT	01295	TIL311
A2DS255	150-1013-00			LAMP,LED:READOUT	01295	TIL311
A2DS275	150-1013-00			LAMP,LED:READOUT	01295	TIL311
A2R263	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A2R269	315-0274-00			RES.,FXD,CMPSN:270K OHM,5%,0.25W	01121	CB2745
A2R287	315-0105-00			RES.,FXD,CMPSN:1M OHM,5%,0.25W	01121	CB1055
A2R288	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A2U295	156-0402-02			MICROCIRCUIT,LI:TIMER CHECKED	27014	SL34829/A+

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A3 DAC		
A3	672-0983-00			CKT BOARD ASSY:DAC	80009	672-0983-00
A3C313	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C323	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C324	283-0666-00			CAP.,FXD,MICA D:890PF,2%,100V	00853	D151F891G0
A3C326	283-0648-00			CAP.,FXD,MICA D:10PF,5%,100V	00853	D151C100D0
A3C333	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C336	283-0780-00			CAP.,FXD,MICA DI:125PF,1%,500V	00853	D155E1250F0
A3C337	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C344	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C345	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C346	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C364	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C365	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
A3C368	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
A3C369	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C371	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C381	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C382	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
A3C385	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C386	290-0779-00			CAP.,FXD,ELCTLT:10UF,+50-10%,50VDC	56289	502D237
A3C388	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C389	290-0779-00			CAP.,FXD,ELCTLT:10UF,+50-10%,50VDC	56289	502D237
A3C391	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C392	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
A3C395	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C396	290-0779-00			CAP.,FXD,ELCTLT:10UF,+50-10%,50VDC	56289	502D237
A3C397	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A3C398	290-0779-00			CAP.,FXD,ELCTLT:10UF,+50-10%,50VDC	56289	502D237
A3C399	281-0812-00			CAP.,FXD,CER DI:1000PF,10%,100V	72982	8035D9AADX7R102K
A3CR371	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR372	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR373	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR375	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR376	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR377	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR378	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR379	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3CR380	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A3F382	159-0128-00			FUSE,CARTRIDGE:2A,125V,5 SEC	75915	273002
A3F386	159-0102-00			FUSE,CARTRIDGE:WIRE LEAD,0.4A,FAST-BLOW	75915	273.400
A3F388	159-0102-00			FUSE,CARTRIDGE:WIRE LEAD,0.4A,FAST-BLOW	75915	273.400
A3Q391	151-0476-00			TRANSISTOR:SILICON,NPN	02735	68430
A3Q392	151-0407-00			TRANSISTOR:SILICON,NPN	04713	SS2456
A3Q395	151-0482-00			TRANSISTOR:SILICON,PNP	80009	151-0482-00
A3Q396	151-0406-00			TRANSISTOR:SILICON,PNP	01295	SGC7282
A3Q397	151-0476-00			TRANSISTOR:SILICON,NPN	02735	68430
A3Q398	151-0407-00			TRANSISTOR:SILICON,NPN	04713	SS2456
A3R323	321-0193-07			RES.,FXD,FILM:1K OHM,0.1%,0.125W	91637	MFF1816C10000B
A3R324	321-0510-00			RES.,FXD,FILM:2M OHM,1%,0.125W	91637	HFF188G20003F
A3R325	131-0566-00			BUS CONDUCTOR:DUMMY RES,2.375,22 AWG	55210	L-2007-1
A3R326	321-0280-00			RES.,FXD,FILM:8.06K OHM,1%,0.125W	91637	MFF1816G80600F
A3R327	321-0305-00			RES.,FXD,FILM:14.7K OHM,1%,0.125W	91637	MFF1816G14701F
A3R328	321-0427-00			RES.,FXD,FILM:274K OHM,1%,0.125W	24546	NA55D2743F
A3R329	311-1238-00			RES.,VAR,NONWIR:5K OHM,10%,0.50W	73138	72X-27-0-502K
A3R333	325-0357-00			RES.,FXD,FILM:800 OHM,0.1%,0.1W	91637	PTF55T16800 OHM

A3 DAC (CONT)

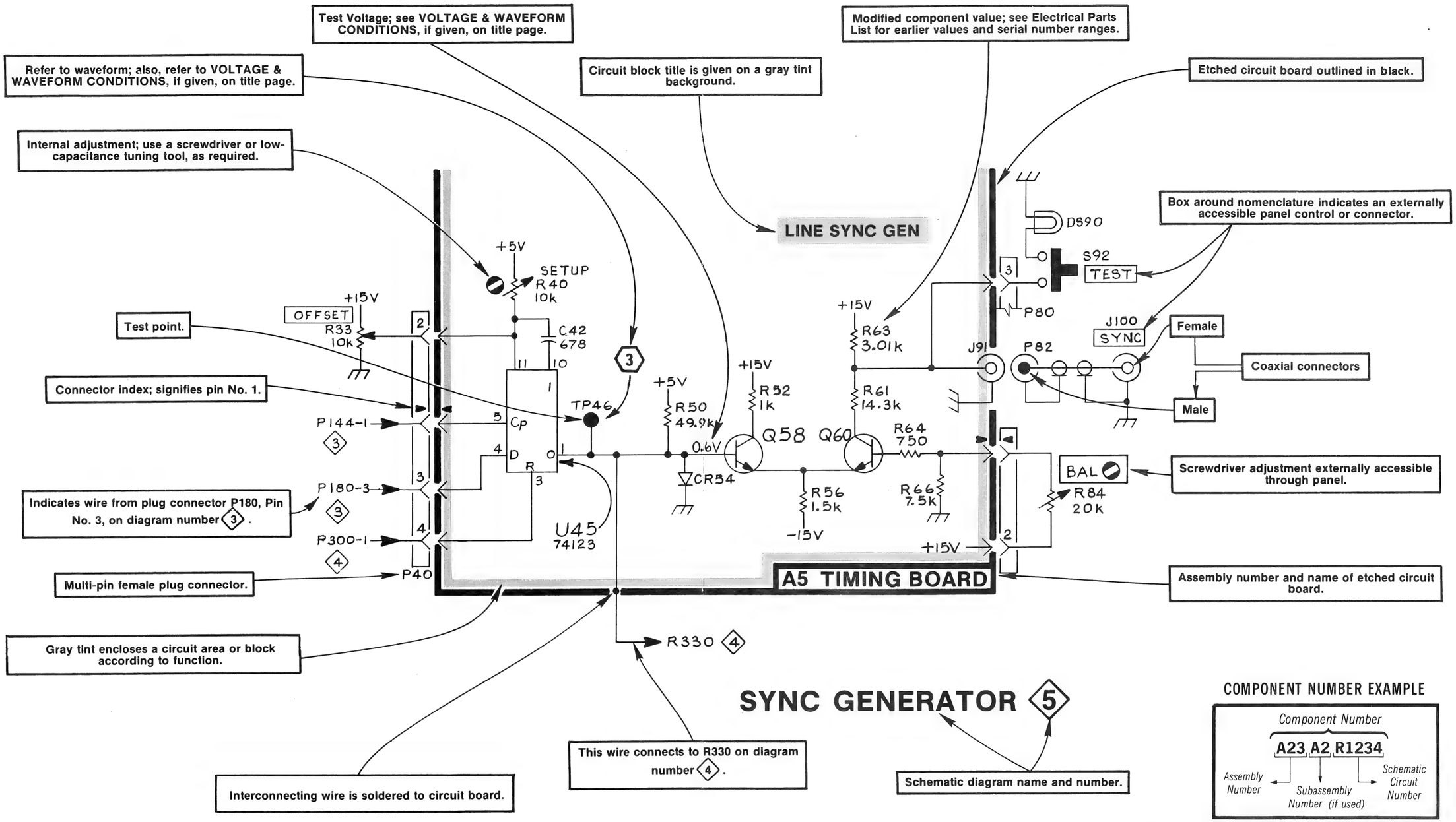
Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A3R334	321-0793-07			RES.,FXD,FILM:37.5 OHM,0.1%,0.125W	91637	CMF110216C37R50B
A3R335	307-0642-00			RES.,THERMAL:10K OHM,5%,25DEG C	15454	DG125103J
A3R336	311-1245-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	72-28-0
A3R337	321-0388-00			RES.,FXD,FILM:107K OHM,1%,0.125W	91637	MFF1816G10702F
A3R338	311-1336-00			RES.,VAR,NONWIR:100K OHM,0.50W	02111	43P104
A3R339	311-1336-00			RES.,VAR,NONWIR:100K OHM,0.50W	02111	43P104
A3R344	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A3R345	325-0357-00			RES.,FXD,FILM:800 OHM,0.1%,0.1W	91637	PTF55T1800 OHM
A3R346	311-1245-00			RES.,VAR,NONWIR:10K OHM,10%,0.50W	73138	72-28-0
A3R348	315-0915-00			RES.,FXD,CMPSN:9.1M OHM,5%,0.25W	01121	CB9155
A3R349	311-1336-00			RES.,VAR,NONWIR:100K OHM,0.50W	02111	43P104
A3R351	307-0446-00			RES,NTWK,FXD FI:10K OHM,20%,(9) RES	91637	MSP10A01-103M
A3R355	307-0446-00			RES,NTWK,FXD FI:10K OHM,20%,(9) RES	91637	MSP10A01-103M
A3R358	321-0926-07			RES.,FXD,FILM:4K OHM,0.1%,0.125W	91637	MFF1816C40000B
A3R361	321-0281-06			RES.,FXD,FILM:8.25K OHM,0.25%,0.125W	91637	MFF1816C82500C
A3R362	321-0264-07			RES.,FXD,FILM:5.49K OHM,0.1%,0.125W	91637	MFF1816C54900B
A3R364	321-0281-06			RES.,FXD,FILM:8.25K OHM,0.25%,0.125W	91637	MFF1816C82500C
A3R365	321-0281-06			RES.,FXD,FILM:8.25K OHM,0.25%,0.125W	91637	MFF1816C82500C
A3R366	321-0264-07			RES.,FXD,FILM:5.49K OHM,0.1%,0.125W	91637	MFF1816C54900B
A3R371	321-0252-00			RES.,FXD,FILM:4.12K OHM,1%,0.125W	91637	MFF1816G41200F
A3R372	321-0707-00			RES.,FXD,FILM:16.5K OHM,0.5%,0.125W	91637	MFF1816G16501D
A3R373	321-0264-07			RES.,FXD,FILM:5.49K OHM,0.1%,0.125W	91637	MFF1816C54900B
A3R374	315-0332-00			RES.,FXD,CMPSN:3.3K OHM,5%,0.25W	01121	CB3325
A3R375	321-0281-06			RES.,FXD,FILM:8.25K OHM,0.25%,0.125W	91637	MFF1816C82500C
A3R376	321-0951-02			RES.,FXD,FILM:5.52K OHM,0.5%,0.125W	24546	NA55D33R2F
A3R381	308-0755-00			RES.,FXD,WW:0.75 OHM,5%,2W	75042	BWH-R7500J
A3R383	307-0056-00			RES.,FXD,CMPSN:4.3 OHM,5%,0.50W	01121	EB43G5
A3R384	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
A3R387	307-0056-00			RES.,FXD,CMPSN:4.3 OHM,5%,0.50W	01121	EB43G5
A3R388	315-0681-00			RES.,FXD,CMPSN:680 OHM,5%,0.25W	01121	CB6815
A3R389	315-0101-00			RES.,FXD,CMPSN:100 OHM,5%,0.25W	01121	CB1015
A3R391	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A3R395	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A3R397	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A3S310	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5MM,W/2 CONTACTS	80009	263-0010-00
A3S311	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5MM,W/2 CONTACTS	80009	263-0010-00
A3S312	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5MM,W/2 CONTACTS	80009	263-0010-00
A3S313	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5MM,W/2 CONTACTS	80009	263-0010-00
A3S314	263-0010-00			SWITCH PB ASSY:1 PUSH,7.5MM,W/2 CONTACTS	80009	263-0010-00
A3S326	263-0079-00			SWITCH,PB ASSY:8 LATCH,7.5MM,16 CONT	80009	263-0079-00
A3TP336	214-0579-00			TERM,TEST POINT:BRS CD PL	80009	214-0579-00
A3U335	156-1338-00			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	18324	NE5534N
A3U345	----- -----			MICROCIRCUIT,LI:BCD,DAC,4 DIGIT		
A3U348	156-1409-01			MICROCIRCUIT,LI:D/A CONV,BCD CODE,CUR OUT	13919	DAC80-CCD-1
A3U353	156-0956-02			MICROCIRCUIT,DI:OCTAL BFR W/3STATE OUT	01295	SN74LS244NP3
A3U357	156-0956-02			MICROCIRCUIT,DI:OCTAL BFR W/3STATE OUT	01295	SN74LS244NP3
A3U368	156-1249-00			MICROCIRCUIT,LI:VOLTAGE REFERENCE	24355	AD40227
A3U371	156-0067-12			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
A3U375	156-0067-12			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
A3U378	156-0067-12			MICROCIRCUIT,LI:OPERATIONAL AMPLIFIER	04713	MC1741CU
A3VR378	152-0291-00			SEMICOND DEVICE:ZENER,1W,20V,5%	04713	1N3027B
A3VR385	152-0291-00			SEMICOND DEVICE:ZENER,1W,20V,5%	04713	1N3027B

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				A4 LOGIC		
A4	670-6660-00			CKT BOARD ASSY:LOGIC	80009	670-6660-00
A4C414	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A4C416	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A4C424	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A4C431	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	8035D9AADC0G270M
A4C455	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
A4C456	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
A4C457	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A4C465	281-0762-00			CAP.,FXD,CER DI:27PF,20%,100V	72982	8035D9AADC0G270M
A4C466	290-0745-00			CAP.,FXD,ELCTLT:22UF,+50-10%,25V	56289	502D225
A4C470	290-0244-00			CAP.,FXD,ELCTLT:0.47UF,5%,35V	56289	162D474X5035BC2
A4C473	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A4C476	283-0779-00			CAP.,FXD,MICA D:27PF,2%,500V	00853	D155E270G0
A4C477	283-0632-00			CAP.,FXD,MICA D:87PF,1%,100V	00853	D151E870F0
A4C480	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A4C484	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A4C486	281-0775-00			CAP.,FXD,CER DI:0.1UF,20%,50V	72982	8005D9AABZ5U104M
A4C488	281-0773-00			CAP.,FXD,CER DI:0.01UF,10%,100V	72982	8005H9AADW5R103K
A4CR410	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR430	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR431	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR432	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR433	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR436	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR437	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR438	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR439	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR440	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR441	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR442	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR443	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR446	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR447	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR448	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR449	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR450	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR451	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR461	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR462	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR463	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4CR487	152-0141-02			SEMICOND DEVICE:SILICON,30V,150MA	01295	1N4152R
A4Q428	151-0459-00			TRANSISTOR:SILICON,PNP	80009	151-0459-00
A4Q431	151-0459-00			TRANSISTOR:SILICON,PNP	80009	151-0459-00
A4Q460	151-0459-00			TRANSISTOR:SILICON,PNP	80009	151-0459-00
A4Q461	151-0460-00			TRANSISTOR:SILICON,NPN	80009	151-0460-00
A4Q462	151-0301-01			TRANSISTOR:SILICON,PNP,PRESTRESSED	80009	151-0301-01
A4Q474	151-0460-00			TRANSISTOR:SILICON,NPN	80009	151-0460-00
A4Q475	151-0460-00			TRANSISTOR:SILICON,NPN	80009	151-0460-00
A4Q477	151-0459-00			TRANSISTOR:SILICON,PNP	80009	151-0459-00
A4Q497	151-0460-00			TRANSISTOR:SILICON,NPN	80009	151-0460-00
A4R410	315-0822-00			RES.,FXD,CMPSN:8.2K OHM,5%,0.25W	01121	CB8225
A4R412	315-0133-00			RES.,FXD,CMPSN:13K OHM,5%,0.25W	01121	CB1335
A4R418	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A4R419	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A4R421	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025

A4 LOGIC (CONT)

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
A4R423	315-0202-00			RES.,FXD,CMPSN:2K OHM,5%,0.25W	01121	CB2025
A4R431	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A4R450	321-0301-00			RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
A4R451	321-0257-00			RES.,FXD,FILM:4.64K OHM,1%,0.125W	91637	MFF1816G46400F
A4R452	321-0230-00			RES.,FXD,FILM:2.43K OHM,1%,0.125W	91637	MFF1816G24300F
A4R453	321-0182-00			RES.,FXD,FILM:768 OHM,1%,0.125W	91637	MFF1816G768R0F
A4R454	307-0446-00			RES,NTWK,FXD FI:10K OHM,20%,(9) RES	91637	MSP10A01-103M
A4R461	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A4R462	315-0104-00			RES.,FXD,CMPSN:100K OHM,5%,0.25W	01121	CB1045
A4R463	315-0103-00			RES.,FXD,CMPSN:10K OHM,5%,0.25W	01121	CB1035
A4R472	315-0226-00			RES.,FXD,CMPSN:22M OHM,5%,0.25W	01121	CB2265
A4R475	315-0161-00			RES.,FXD,CMPSN:160 OHM,5%,0.25W	01121	CB1615
A4R476	315-0102-00			RES.,FXD,CMPSN:1K OHM,5%,0.25W	01121	CB1025
A4R477	315-0473-00			RES.,FXD,CMPSN:47K OHM,5%,0.25W	01121	CB4735
A4R478	315-0273-00			RES.,FXD,CMPSN:27K OHM,5%,0.25W	01121	CB2735
A4R479	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A4R480	321-0301-00			RES.,FXD,FILM:13.3K OHM,1%,0.125W	91637	MFF1816G13301F
A4R487	315-0391-00			RES.,FXD,CMPSN:390 OHM,5%,0.25W	01121	CB3915
A4R489	315-0682-00			RES.,FXD,CMPSN:6.8K OHM,5%,0.25W	01121	CB6825
A4R498	315-0222-00			RES.,FXD,CMPSN:2.2K OHM,5%,0.25W	01121	CB2225
A4U404	156-0914-02			MICROCIRCUIT,DI:OCT ST BFR W/3 STATE OUT	01295	SN74LS240
A4U406	156-0914-02			MICROCIRCUIT,DI:OCT ST BFR W/3 STATE OUT	01295	SN74LS240
A4U412	156-0569-00			MICROCIRCUIT,DI:BCD COUNTER	27014	DM74LS190
A4U414	156-0569-00			MICROCIRCUIT,DI:BCD COUNTER	27014	DM74LS190
A4U415	156-0569-00			MICROCIRCUIT,DI:BCD COUNTER	27014	DM74LS190
A4U416	156-0569-00			MICROCIRCUIT,DI:BCD COUNTER	27014	DM74LS190
A4U421	156-1114-01			MICROCIRCUIT,LI:OPERATIONAL AMP,TESTED	80009	156-1114-01
A4U423	156-0953-02			MICROCIRCUIT,DI:4 BIT MAGNITUDE CMPRTR	01295	SN74LS85
A4U425	156-0865-02			MICROCIRCUIT,DI:OCTAL D-TYPE FF W/CLEAR	01295	SN74LS273NP3
A4U426	156-0953-02			MICROCIRCUIT,DI:4 BIT MAGNITUDE CMPRTR	01295	SN74LS85
A4U427	156-0865-02			MICROCIRCUIT,DI:OCTAL D-TYPE FF W/CLEAR	01295	SN74LS273NP3
A4U442	156-0953-02			MICROCIRCUIT,DI:4 BIT MAGNITUDE CMPRTR	01295	SN74LS85
A4U444	160-0811-00			MICROCIRCUIT,DI:2048 X 8 EPROM PROGRAMMED	80009	160-0811-00
A4U446	156-0953-02			MICROCIRCUIT,DI:4 BIT MAGNITUDE CMPRTR	01295	SN74LS85
A4U453	156-0383-00			MICROCIRCUIT,DI:QUAD 2-INPUT NOR GATE	80009	156-0383-00
A4U454	156-0388-03			MICROCIRCUIT,DI:DUAL D FLIP-FLOP	07263	74LS74D
A4U456	156-1176-01			MICROCIRCUIT,DI:8/3 LINE PRIORITY ENCODER	80009	156-1176-01
A4U458	156-1176-01			MICROCIRCUIT,DI:8/3 LINE PRIORITY ENCODER	80009	156-1176-01
A4U470	156-0402-02			MICROCIRCUIT,LI:TIMER,CHECKED	27014	SL34829/A+
A4U473	156-0388-03			MICROCIRCUIT,DI:DUAL D FLIP-FLOP	07263	74LS74D
A4U474	156-0382-02			MICROCIRCUIT,DI:QUAD 2-INP NAND GATE	01295	SN74LS00
A4U482	156-0646-02			MICROCIRCUIT,DI:4 BIT BINARY COUNTER	80009	156-0646-02
A4U493	156-0646-02			MICROCIRCUIT,DI:4 BIT BINARY COUNTER	80009	156-0646-02
A4U494	156-0646-02			MICROCIRCUIT,DI:4 BIT BINARY COUNTER	80009	156-0646-02
A4U495	156-0646-02			MICROCIRCUIT,DI:4 BIT BINARY COUNTER	80009	156-0646-02
A4Y478	158-0219-00			XTAL UNIT,QTZ:8.83852MHZ,0.005%	33096	PB1336
A4Y488	158-0220-00			XTAL UNIT,QTZ:9.9112MHZ,0.005%	33096	PB1337

Component No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Name & Description	Mfr Code	Mfr Part Number
				CHASSIS PARTS		
DS76	150-1052-00			LT EMITTING DIO:RED,655NM,50MA	72619	559-0101-001
R11	311-0959-00			RES.,VAR,WW:10K OHM,5%,1.5W	71590	BA02510010
R36	311-1310-00			RES.,VAR,NONWIR:20K OHM,20%,1W	01121	10M654
S15 S35 S55 S75	260-2002-00			SWITCH,LEVER:4 SECT,10 POSN,BCD CODING		



COMPONENT NUMBER EXAMPLE

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

SCHEMATIC EXAMPLE

DIAGRAMS & CIRCUIT BOARD ILLUSTRATIONS

This section of the manual contains block and schematic diagrams with waveforms, and etched circuit board illustrations.

Symbols

Symbols used on the diagrams are based on ANSI Y32.2-1970 and IEEE No. 315 March 1971. Logic symbology is based on ANSI Y32.14-1973 (IEEE Std. 91-1973). Logic symbols depict the logic function performed and may differ from the manufacturer's data.

Component Values

Electrical components shown on the diagrams are in the following units unless noted otherwise:

Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in micofarads (μF).

Resistors = Ohms (Ω).

Semiconductor Types

Refer to the Electrical Parts List.

Reference Designators

The following letters are used as reference designators to identify components or assemblies on Tektronix, Inc. schematic diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DH	Decoupling Hybrid
DL	Delay Line
DS	Indicating device (lamp)
E	Spark Gap
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
P	Connector, movable portion
Q	Transistor, silicon-controlled rectifier, or programmable unijunction transistor
R	Resistor, fixed or variable
RT	Thermistors
S	Switch
T	Transformer
TC	Thermocouple
TP	Test Point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

Partial Schematic Diagram With Explanations

The partial diagram at the left is an example of the various symbols and other information provided on Tektronix, Inc. diagrams.

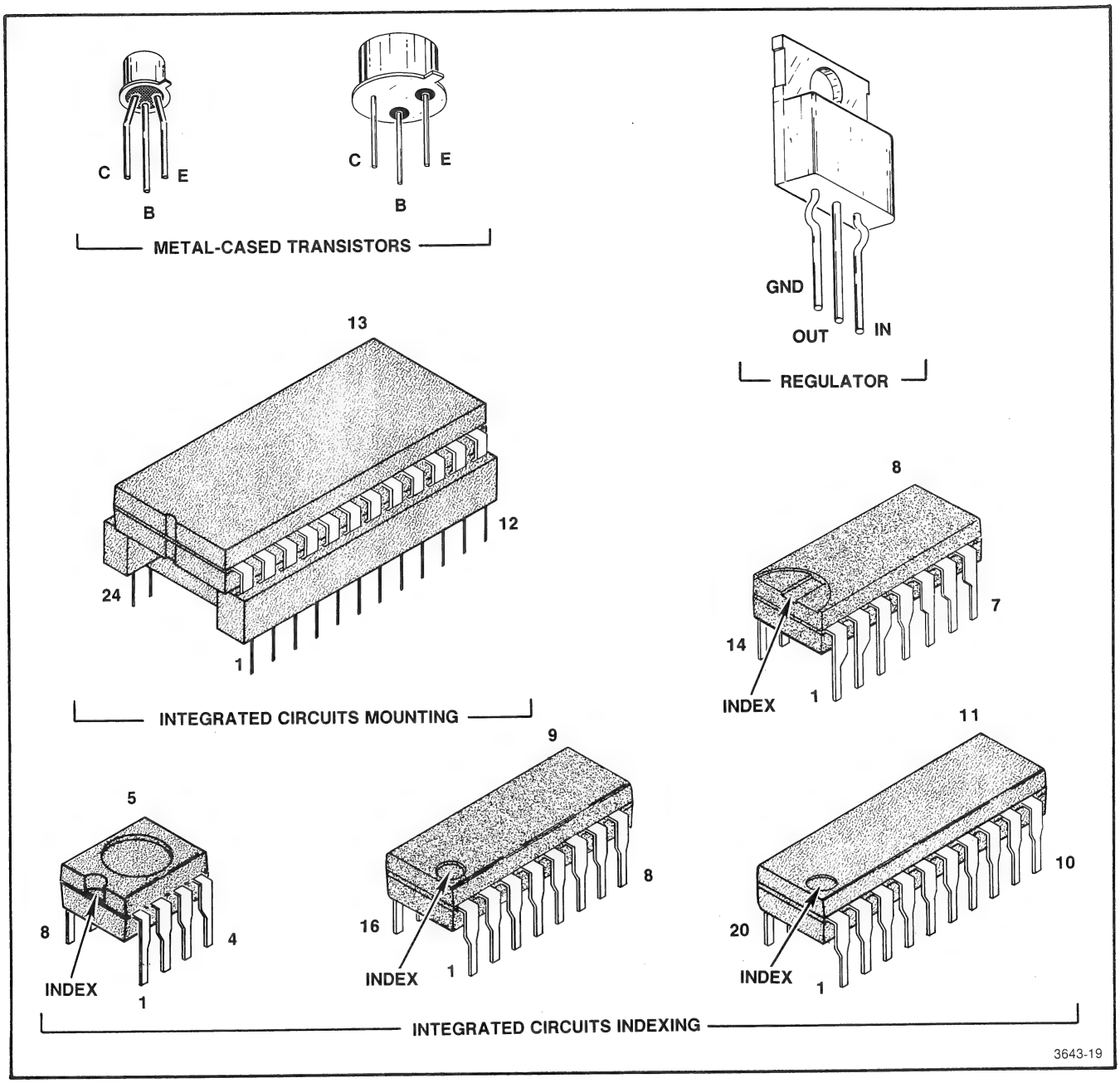


FIGURE. 8-1 SEMICONDUCTOR BIASING.

@

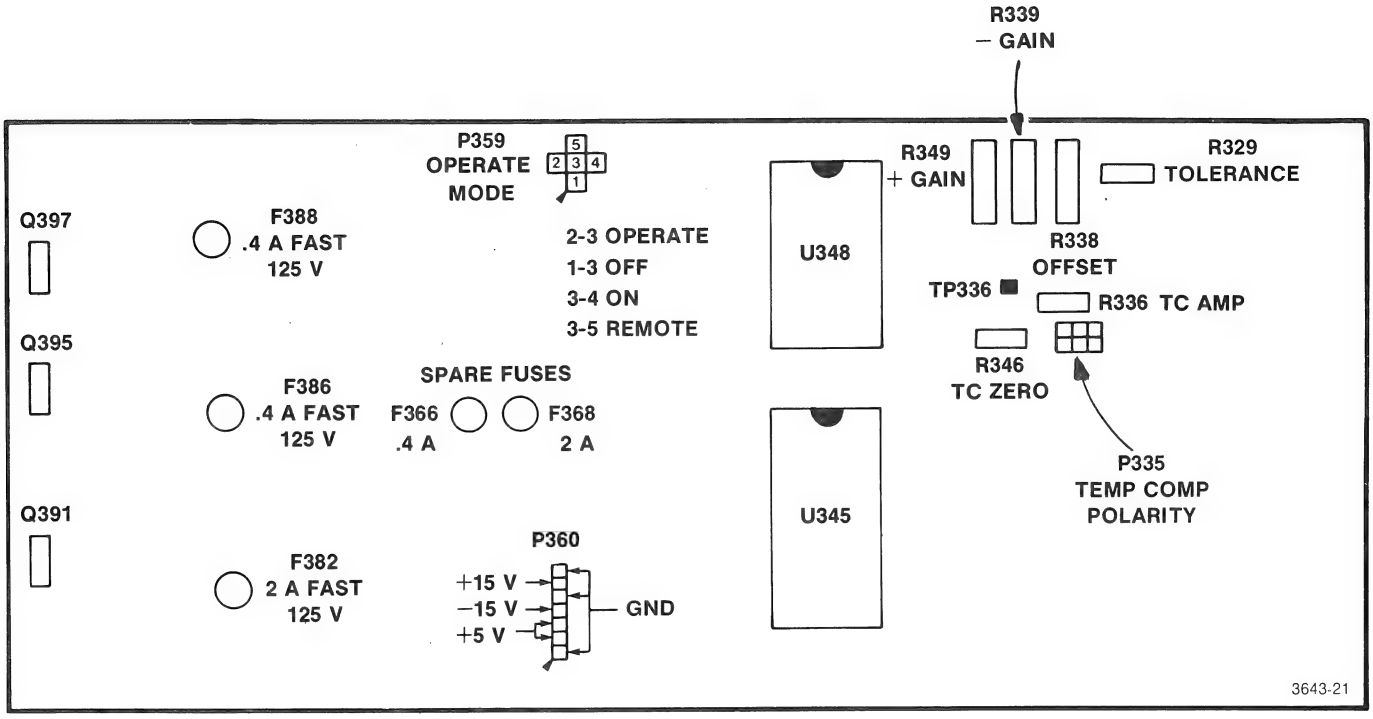
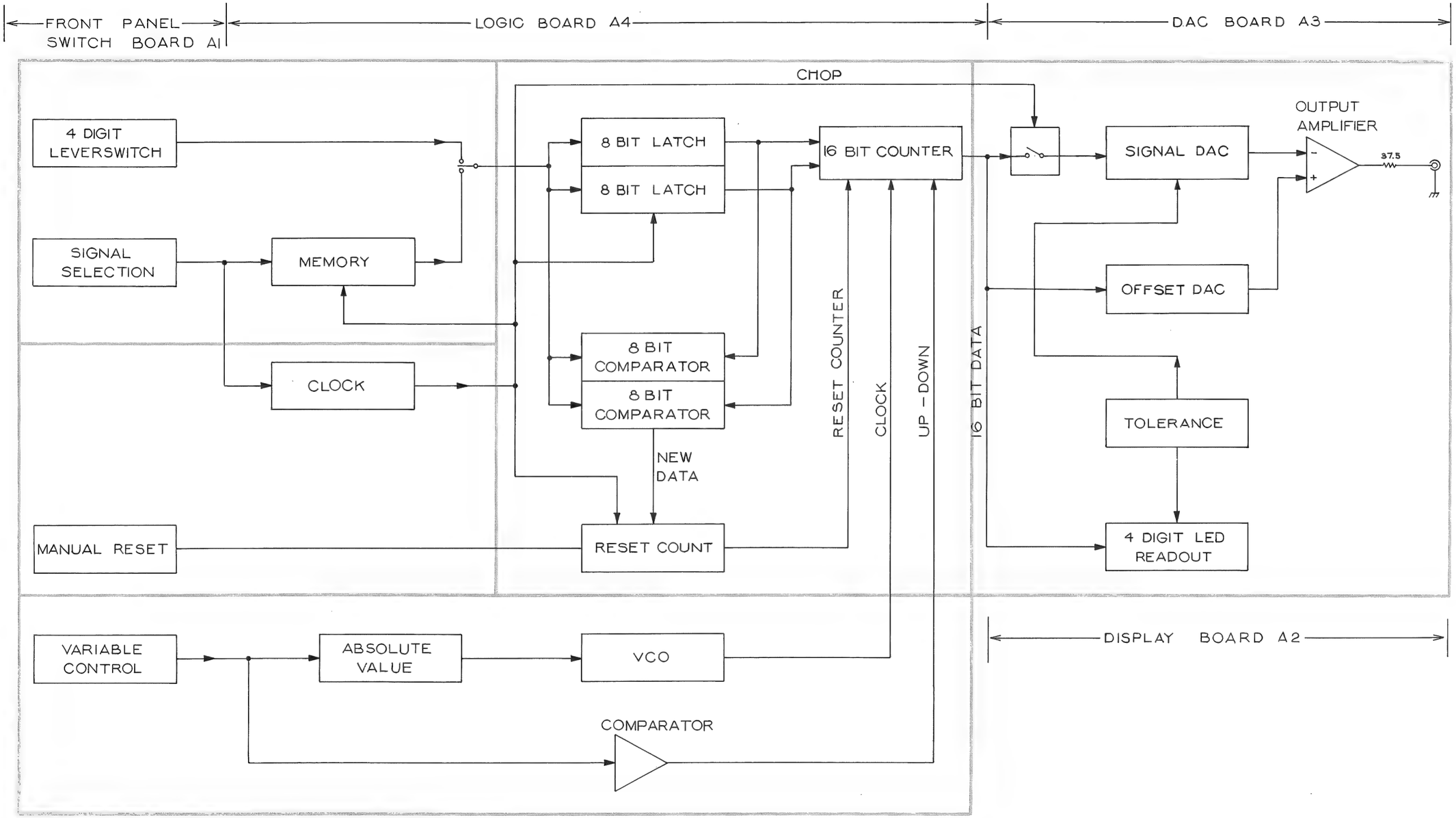


FIGURE 8-2. A3 DAC BOARD ADJUSTMENT LOCATIONS.

@



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BLOCK DIAGRAM

067-0916-00

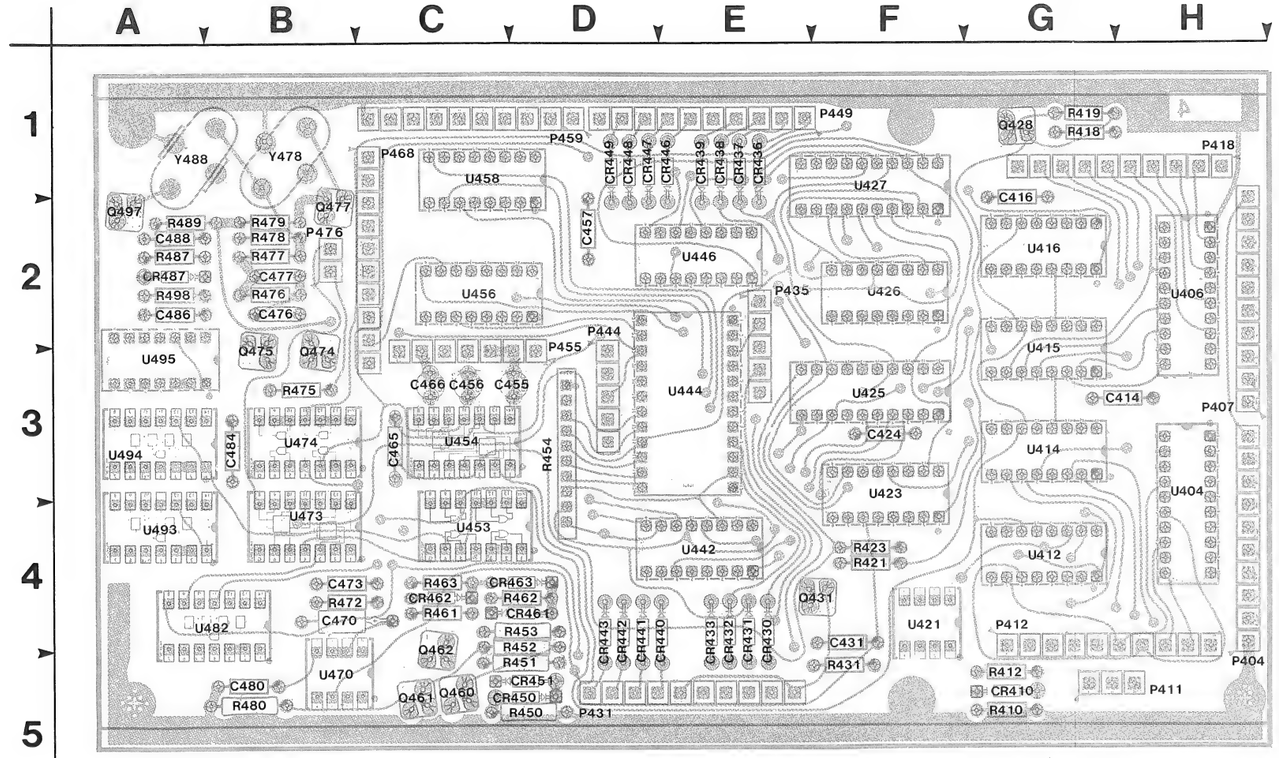
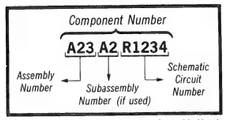


FIGURE 8-3. A4 LOGIC BOARD COMPONENT LOCATIONS.

NOTE: In Figure 8-3 the components are illustrated as if looking through the back of the board.

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices
See Maintenance Section

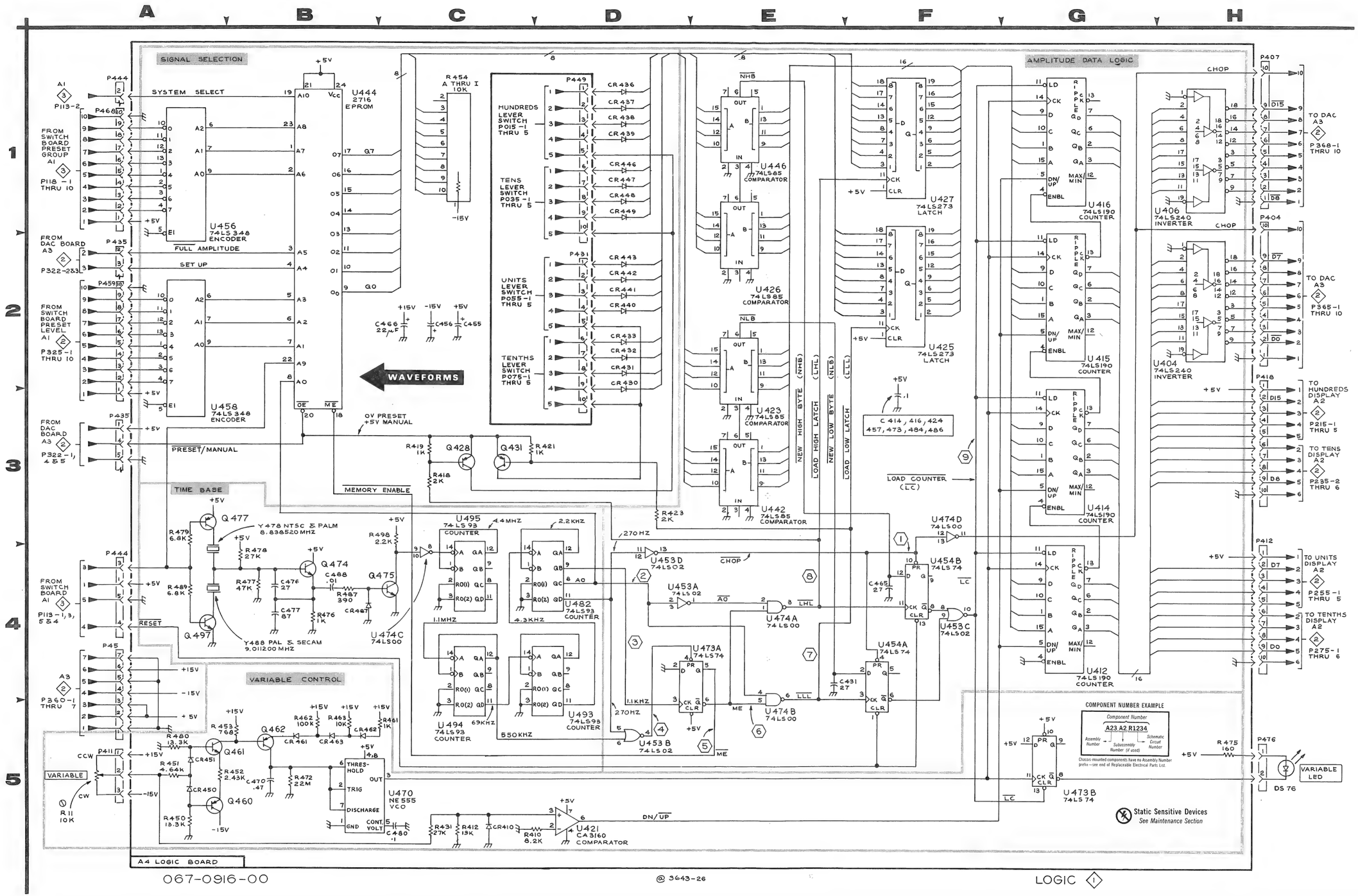
LOGIC DIAGRAM 1

ASSEMBLY A4

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C414	F3	H3	P411	A5	H5	R479	A3	B2
C416	F3	G2	P412	H4	G4	R480	A5	B5
C424	F3	F3	P418	H2	H1	R487	B4	A2
C431	F4	F4	P431	D2	D5	R489	A4	A2
C455	C2	C3	P435	A2	E2	R498	C3	A2
C456	C2	C3	P435	A3	E2			
C457	F3	D2	P444	A1	D2	U404	H2	H3
C465	F4	C3	P444	A4	D2	U406	H1	H2
C466	C2	C3	P449	D1	F1	U412	G4	G4
C470	B5	B4	P455	A4	D2	U414	G3	G3
C473	F3	B4	P459	A2	D1	U415	G2	G3
C476	B4	B2	P468	A1	C1	U416	G1	G2
C477	B4	B2	P476	H5	B2	U421	D5	F4
C480	C5	B5				U423	E3	F3
C484	F3	B3	Q428	C3	G1	U425	F2	F3
C486	F3	A2	Q431	C3	E4	U426	E2	F2
C488	B4	A2	Q460	A5	C5	U427	F1	F1
			Q461	A5	C5	U442	E3	E4
CR410	C5	G5	Q462	B5	C4	U444	B1	E3
CR430	D2	E4	Q474	B4	B3	U446	E1	E2
CR431	D2	E4	Q475	C4	B3	U453A	D4	C4
CR432	D2	E4	Q477	A3	B2	U453B	D5	C4
CR433	D2	E4	Q497	A4	A2	U453C	F4	C4
CR436	D1	E1				U453D	D4	C4
CR437	D1	E1	R410	C5	G5	U454A	F4	C3
CR438	D1	E1	R412	C5	G5	U454B	F4	C3
CR439	D1	E1	R418	C3	G1	U456	A1	C2
CR440	D2	E4	R419	C3	G1	U458	A3	C1
CR441	D2	D4	R421	C3	F4	U470	C5	B5
CR442	D2	D4	R423	D3	F4	U473A	E4	B4
CR443	D2	D4	R431	C5	F5	U473B	G5	B4
CR446	D1	E1	R450	A5	D5	U474A	E4	B3
CR447	D1	D1	R451	A5	D5	U474B	E5	B3
CR448	D1	D1	R452	A5	D4	U474C	C4	B3
CR449	D1	D1	R453	B5	D4	U474D	F3	B3
CR450	A5	D5	R454	C1	D3	U482	D4	B4
CR451	A5	D5	R461	C5	C4	U493	D5	A4
CR461	B5	D4	R462	B5	D4	U494	C5	A3
CR462	B5	C4	R463	B5	C4	U495	C3	A3
CR463	B5	C4	R472	B5	B4			
CR487	B4	A2	R475	H5	B3	Y478	A4	B1
			R476	B4	B2	Y488	A4	A1
P404	H1	H5	R477	B4	B2			
P407	H1	H3	R478	B4	B2			

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
DS76	H5	CHASSIS	R11	A5	CHASSIS			


SIGNAL SELECTION
AMPLITUDE DATA LOGIC
TIME BASE
VARIABLE CONTROL
SYSTEM SELECT
FULL AMPLITUDE
SET UP
PRESET/MANUAL
MEMORY ENABLE
WAVEFORMS
0V PRESET
+5V MANUAL
HUNDREDS LEVER SWITCH P015-1 THRU 5
TENS LEVER SWITCH P035-1 THRU 5
UNITS LEVER SWITCH P055-1 THRU 5
TENTHS LEVER SWITCH P075-1 THRU 5
FROM SWITCH BOARD PRESET GROUP A1
FROM SWITCH BOARD PRESET LEVEL A1
FROM DAC BOARD A3
FROM SWITCH BOARD A1
U456 74LS348 ENCODER
U458 74LS348 ENCODER
U444 2716 EPROM
U446 74LS85 COMPARATOR
U426 74LS85 COMPARATOR
U423 74LS85 COMPARATOR
U442 74LS85 COMPARATOR
U421 CA3160 COMPARATOR
U427 74LS273 LATCH
U425 74LS273 LATCH
U416 74LS190 COUNTER
U415 74LS190 COUNTER
U414 74LS190 COUNTER
U412 74LS190 COUNTER
U406 74LS240 INVERTER
U404 74LS240 INVERTER
U495 74LS93 COUNTER
U482 74LS93 COUNTER
U494 74LS93 COUNTER
U493 74LS93 COUNTER
U470 NE 555 VCO
U453D 74LS02
U453A 74LS02
U453B 74LS02
U474A 74LS00
U474B 74LS00
U474C 74LS00
U474D 74LS00
U454B 74LS74
U454A 74LS74
U473A 74LS74
U473B 74LS74
LOAD COUNTER (LC)
LOAD LOW LATCH (LLL)
LOAD HIGH LATCH (LHL)
NEW LOW BYTE (NLB)
NEW HIGH BYTE (NHB)
CHOP
TO DAC A3 P368-1 THRU 10
TO DAC A3 P365-1 THRU 10
TO HUNDREDS DISPLAY A2 P215-1 THRU 5
TO TENS DISPLAY A2 P235-2 THRU 6
TO UNITS DISPLAY A2 P255-1 THRU 5
TO TENTHS DISPLAY A2 P275-1 THRU 6
VARIABLE LED
DS 76
R11 10K
Y478 NTSC & PALM 8.838520 MHZ
Y488 PAL & SECAM 9.011200 MHZ
C414, 416, 424 457, 473, 484, 486
COMPONENT NUMBER EXAMPLE
Component Number
A23 A2 R1234
Assembly Number
Subassembly Number (if used)
Schematic Circuit Number
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.
Static Sensitive Devices
See Maintenance Section
A4 LOGIC BOARD

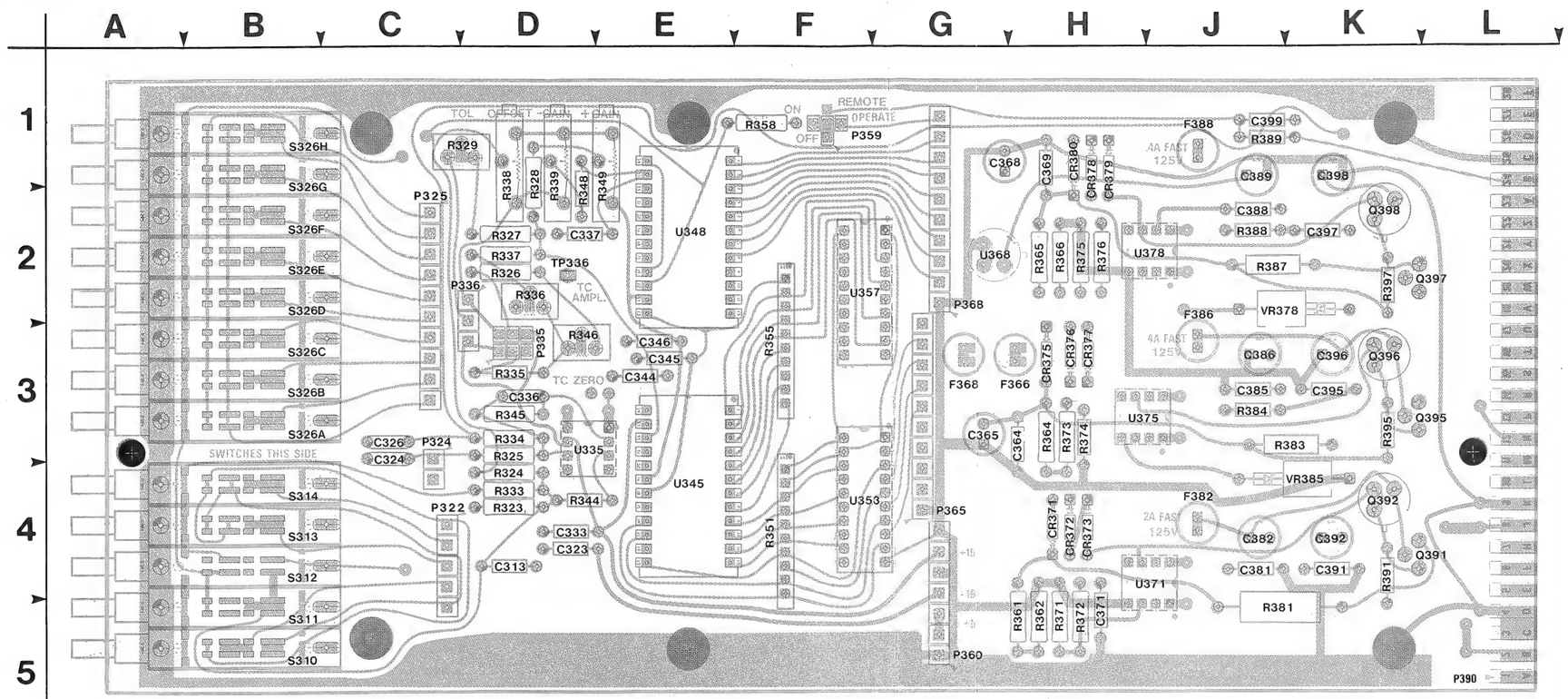


FIGURE 8-5. A3 DAC BOARD COMPONENT LOCATIONS.

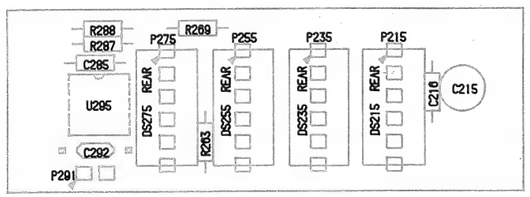
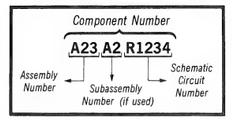


FIGURE 8-6. A2 DISPLAY BOARD COMPONENT LOCATIONS.

NOTE: In Figure 8-5 the components are illustrated as if looking through the back of the board.

In Figure 8-6 the components are illustrated in the normal manner as if looking directly down on the board.

COMPONENT NUMBER EXAMPLE



Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices
See Maintenance Section

DISPLAY & DAC DIAGRAM ◇2

ASSEMBLY A2

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C215	A1	D7	DS275	A3	B7	R263	B3	B7
C216	B1	D7				R269	A4	B6
C285	A4	A7	P215	A1	C6	R287	A4	B6
C292	A4	A7	P235	A2	C6	R288	A4	B6
			P255	A2	B6			
DS215	A1	C7	P275	A3	B6	U295	A4	A7
DS235	A2	C7	P291	A4	A7			
DS255	A3	B7						

ASSEMBLY A3

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
C313	G2	D4	P324	H2	C3	R365	E4	H2
C323	C3	D4	P325	H4	C2	R366	D4	H2
C324	H1	C3	P335	G1	D3	R371	D2	H5
C326	H2	C3	P336	H1	D2	R372	D2	H5
C333	C2	D4	P359	C1	F1	R373	D5	H3
C336	G1	D3	P360	H5	G5	R374	D5	H3
C337	F2	D2	P365	B2	G4	R375	D4	H2
C344	C2	E3	P368	B1	G2	R376	D4	H2
C345	C2	E3	P390	B3	L5	R381	E3	J5
C346	C3	E3	P390	B4	L5	R383	F5	K3
C364	E5	H3	P390	B5	L5	R384	C5	J3
C365	E5	G3	P390	H1	L5	R387	F4	J2
C368	E4	G1	P390	H2	L5	R388	C4	J2
C369	E4	H1				R389	C3	J1
C371	D5	H5	Q391	E3	L4	R391	E3	K4
C381	C4	J4	Q392	E3	K4	R395	E5	K3
C382	C4	J4	Q395	F5	L3	R397	E4	K2
C385	D5	J3	Q396	E5	K3			
C386	D5	J3	Q397	F4	L2	S310	G3	B5
C388	C4	J2	Q398	E4	K2	S311	G3	B5
C389	D4	J1				S312	G3	B4
C391	E4	K4	R323	G2	D4	S313	G2	B4
C392	E4	K4	R324	G3	D4	S314	G2	B4
C395	C5	K3	R325	H1	D3	S326A	G5	B3
C396	C5	K3	R326	H1	D2	S326B	G5	B3
C397	C4	K2	R327	G1	D2	S326C	G4	B3
C398	C4	K1	R328	G1	D1	S326D	G4	B2
C399	C3	J1	R329	H1	D1	S326E	G4	B2
			R333	G2	D4	S326F	G4	B2
CR371	E3	H4	R334	H2	D3	S326G	G4	B2
CR372	E3	H4	R335	G1	D3	S326H	G4	B1
CR373	E3	H4	R336	G1	D2			
CR375	E5	H3	R337	G1	D2	TP336	G1	D2
CR376	E5	H3	R338	G3	D1			
CR377	E5	H3	R339	G2	D1	U335	G2	D3
CR378	E4	H1	R344	G2	D4	U345	F1	E4
CR379	E4	H1	R345	G1	D3	U348	F2	E2
CR380	E4	H1	R346	G1	D3	U353	D2	F4
			R348	F2	D2	U357	D2	F2
F366	C3	H3	R349	F1	E1	U368	D4	G2
F368	C3	G3	R351	E3	F4	U371	E3	J4
F382	C4	J4	R355	E2	F3	U375	E5	H3
F386	C5	J2	R358	G3	F1	U378	E4	J2
F388	C4	J1	R361	D2	H5			
			R362	D4	H5	VR378	C4	J2
P322	H2	C4	R364	E5	H3	VR385	C5	K4

CHASSIS MOUNTED PARTS

CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION	CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
J24	H2	CHASSIS	R36	H1	CHASSIS	S36A	H1	CHASSIS
						S36B	A4	CHASSIS

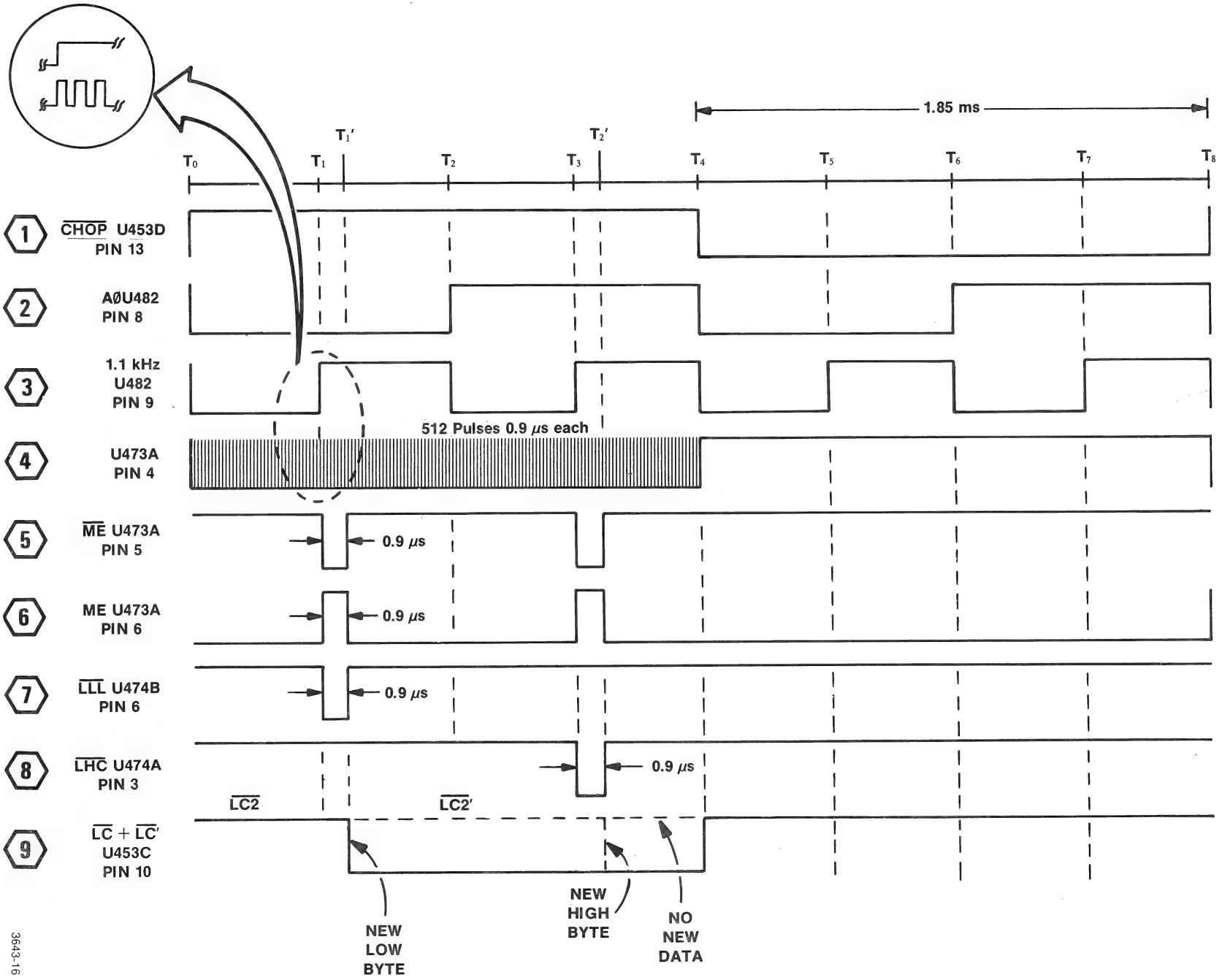


FIGURE 8-4. WAVEFORMS FOR LOGIC BOARD A4.

3643-16

A2 DISPLAY BOARD

A3 DAC BOARD

P335 - TEMP. COMP. POLARITY - USED IN CALIBRATION

COMPONENT NUMBER EXAMPLE

Component Number: A23 A2 R1234 (Assembly Number · Subassembly Number (if used) · Schematic Circuit Number)

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices — See Maintenance Section

NOTE: +5V TO DISPLAY BOARD A2 & SWITCH BOARD A1 GOES VIA LOGIC BOARD A4

067-0916-00

@3643-27

067-0916-00

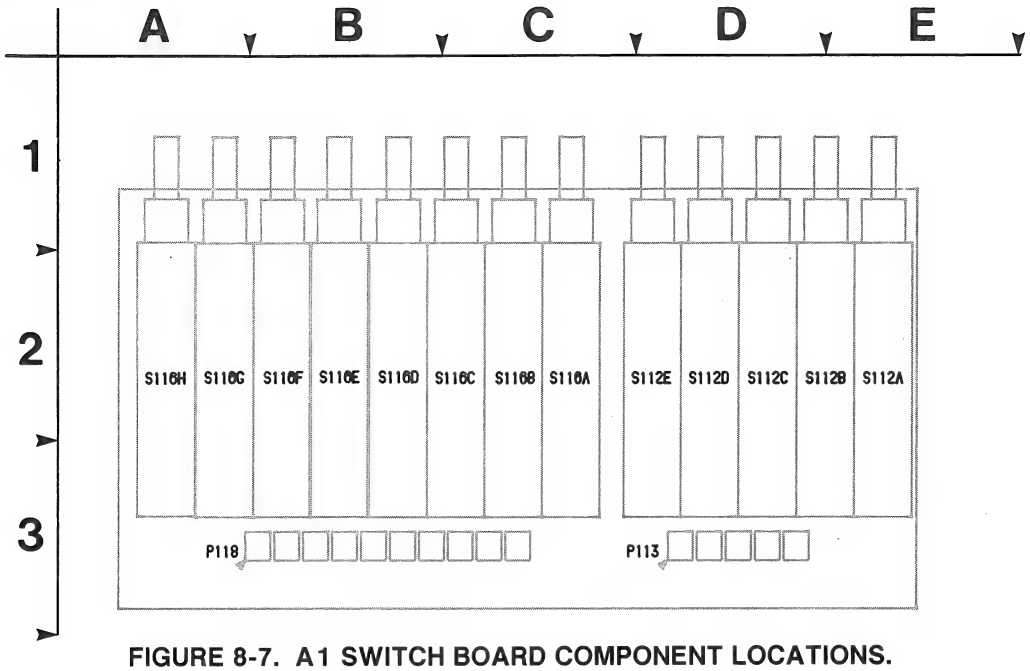
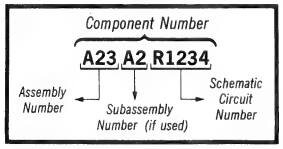


FIGURE 8-7. A1 SWITCH BOARD COMPONENT LOCATIONS.

NOTE: In Figure 8-7 the components are illustrated in the normal manner as if looking directly down on the board.

SWITCH & FRONT PANEL LEVERSWITCH DIAGRAM 3

COMPONENT NUMBER EXAMPLE

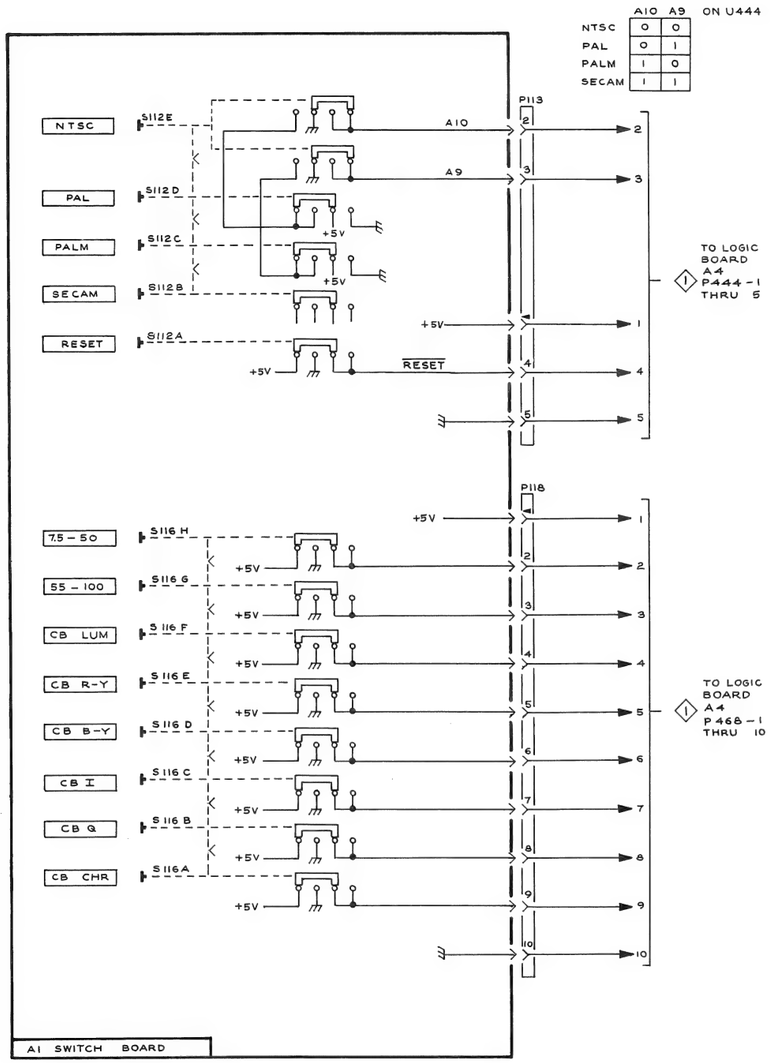


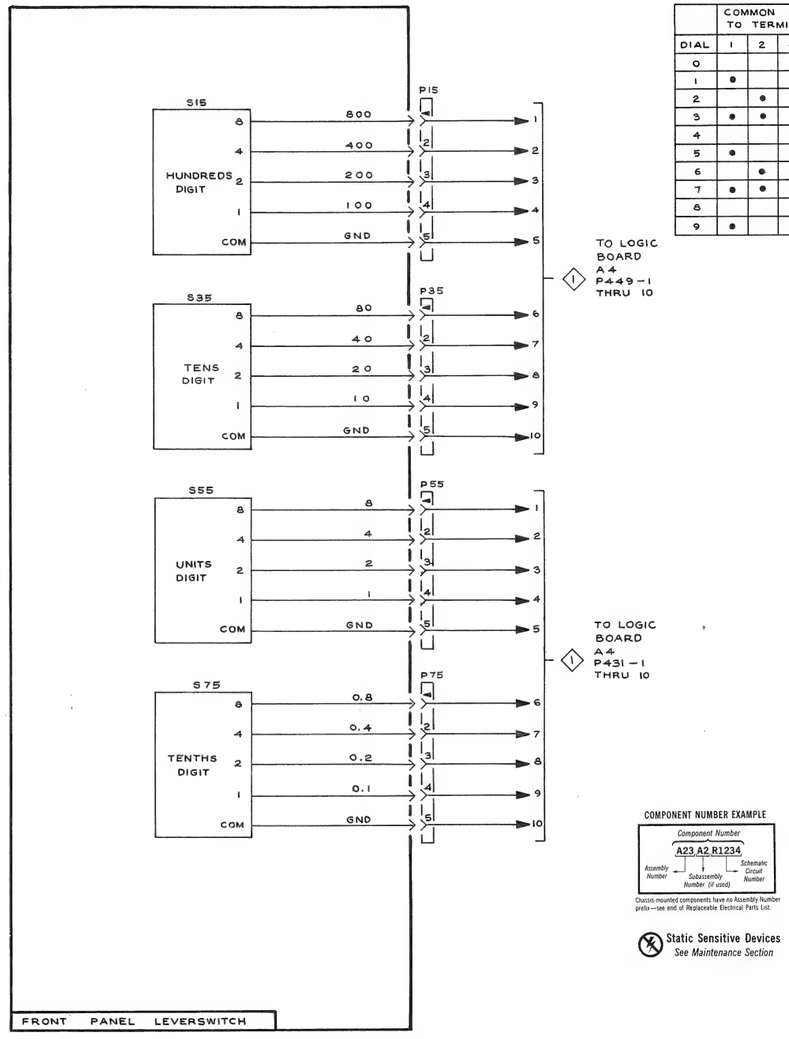
Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices
See Maintenance Section

ASSEMBLY A1		
CIRCUIT NUMBER	SCHEM NUMBER	SCHEM LOCATION
P113	C1	D3
P118	C3	A3
S112A	B2	E2
S112B	B2	D2
S112C	B2	D2
S112D	B1	D2
S112E	B1	D2
S116A	B4	C2
S116B	B4	C2
S116C	B4	C2
S116D	B4	B2
S116E	B3	B2
S116F	B3	B2
S116G	B3	A2
S116H	B3	A2

CHASSIS MOUNTED PARTS		
CIRCUIT NUMBER	SCHEM LOCATION	BOARD LOCATION
S15	E1	CHASSIS
S35	E2	CHASSIS
S55	E3	CHASSIS
S75	E4	CHASSIS





DIAL	COMMON CONN. TO TERMINALS: 1	2	4	8
0				
1	•			
2		•		
3	•	•		
4			•	
5	•		•	
6		•	•	
7	•	•	•	
8				•
9	•			•

COMPONENT NUMBER EXAMPLE

Component Number: A23 A2 R1234
Assembly Number · Subassembly Number (if used) · Schematic Circuit Number

Chassis-mounted components have no Assembly Number prefix—see end of Replaceable Electrical Parts List.

Static Sensitive Devices
See Maintenance Section

067-0916-00

@ 3643-28

SWITCH & FRONT PANEL LEVERSWITCH ◇3

REPLACEABLE MECHANICAL PARTS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix, Inc. Field Office or representative.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number, instrument type or number, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix, Inc. Field Office or representative will contact you concerning any change in part number.

Change information, if any, is located at the rear of this manual.

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number
00X	Part removed after this serial number

FIGURE AND INDEX NUMBERS

Items in this section are referenced by figure and index numbers to the illustrations.

INDENTATION SYSTEM

This mechanical parts list is indented to indicate item relationships. Following is an example of the indentation system used in the description column.

1 2 3 4 5 Name & Description

Assembly and/or Component
Attaching parts for Assembly and/or Component
\- - - * - - -
Detail Part of Assembly and/or Component
Attaching parts for Detail Part
\- - - * - - -
Parts of Detail Part
Attaching parts for Parts of Detail Part
\- - - * - - -

Attaching Parts always appear in the same indentation as the item it mounts, while the detail parts are indented to the right. Indented items are part of, and included with, the next higher indentation. The separation symbol - - - * - - - indicates the end of attaching parts.

Attaching parts must be purchased separately, unless otherwise specified.

ITEM NAME

In the Parts List, an Item Name is separated from the description by a colon (:). Because of space limitations, an Item Name may sometimes appear as incomplete. For further Item Name identification, the U.S. Federal Cataloging Handbook H6-1 can be utilized where possible.

ABBREVIATIONS

"	INCH
#	NUMBER SIZE
ACTR	ACTUATOR
ADPTR	ADAPTER
ALIGN	ALIGNMENT
AL	ALUMINUM
ASSEM	ASSEMBLED
ASSY	ASSEMBLY
ATTEN	ATTENUATOR
AWG	AMERICAN WIRE GAGE
BD	BOARD
BRKT	BRACKET
BRS	BRASS
BRZ	BRONZE
BSHG	BUSHING
CAB	CABINET
CAP	CAPACITOR
CER	CERAMIC
CHAS	CHASSIS
CKT	CIRCUIT
COMP	COMPOSITION
CONN	CONNECTOR
COV	COVER
CPLG	COUPLING
CRT	CATHODE RAY TUBE
DEG	DEGREE
DWR	DRAWER
ELCTRN	ELECTRON
ELEC	ELECTRICAL
ELCTLT	ELECTROLYTIC
ELEM	ELEMENT
EPL	ELECTRICAL PARTS LIST
EQPT	EQUIPMENT
EXT	EXTERNAL
FIL	FILLISTER HEAD
FLEX	FLEXIBLE
FLH	FLAT HEAD
FLTR	FILTER
FR	FRAME or FRONT
FSTNR	FASTENER
FT	FOOT
FXD	FIXED
GSKT	GASKET
HDL	HANDLE
HEX	HEXAGON
HEX HD	HEXAGONAL HEAD
HEX SOC	HEXAGONAL SOCKET
HLCPS	HELICAL COMPRESSION
HLEXT	HELICAL EXTENSION
HV	HIGH VOLTAGE
IC	INTEGRATED CIRCUIT
ID	INSIDE DIAMETER
IDENT	IDENTIFICATION
IMPLR	IMPELLER
IN	INCH
INCAND	INCANDESCENT
INSUL	INSULATOR
INTL	INTERNAL
LPHLDR	LAMPHOLDER
MACH	MACHINE
MECH	MECHANICAL
MTG	MOUNTING
NIP	NIPPLE
NON WIRE	NOT WIRE WOUND
OBD	ORDER BY DESCRIPTION
OD	OUTSIDE DIAMETER
OVH	OVAL HEAD
PH BRZ	PHOSPHOR BRONZE
PL	PLAIN or PLATE
PLSTC	PLASTIC
PN	PART NUMBER
PNH	PAN HEAD
PWR	POWER
RCPT	RECEPTACLE
RES	RESISTOR
RGD	RIGID
RLF	RELIEF
RTNR	RETAINER
SCH	SOCKET HEAD
SCOPE	OSCILLOSCOPE
SCR	SCREW
SE	SINGLE END
SECT	SECTION
SEMICOND	SEMICONDUCTOR
SHLD	SHIELD
SHLDR	SHOULDERED
SKT	SOCKET
SL	SLIDE
SLFLKG	SELF-LOCKING
SLVG	SLEEVING
SPR	SPRING
SQ	SQUARE
SST	STAINLESS STEEL
STL	STEEL
SW	SWITCH
T	TUBE
TERM	TERMINAL
THD	THREAD
THK	THICK
TNSN	TENSION
TPG	TAPPING
TRH	TRUSS HEAD
V	VOLTAGE
VAR	VARIABLE
W/	WITH
WSHR	WASHER
XFMR	TRANSFORMER
XSTR	TRANSISTOR

CROSS INDEX—MFR. CODE NUMBER TO MANUFACTURER

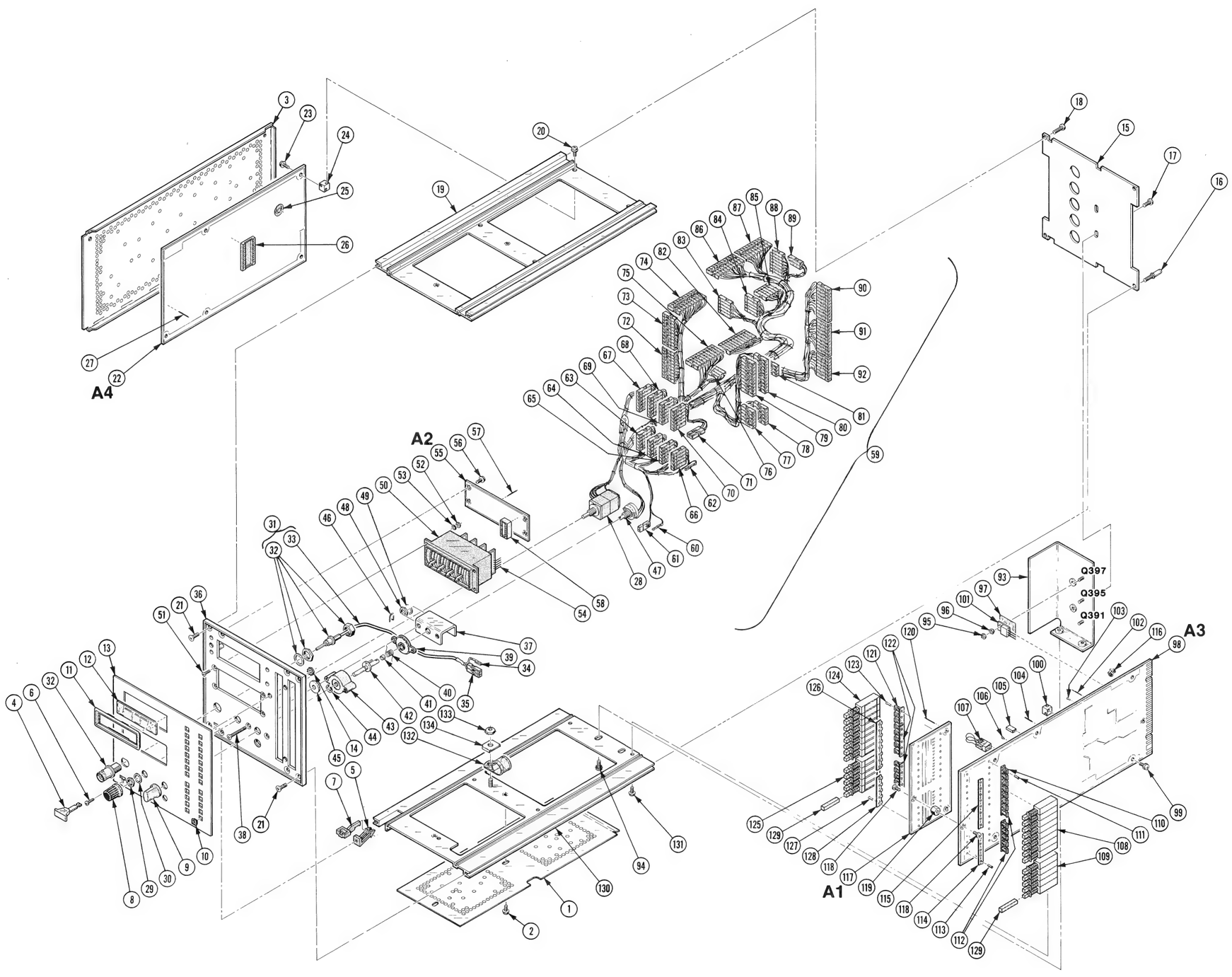
Mfr. Code	Manufacturer	Address	City, State, Zip
00779	AMP, INC.	P O BOX 3608	HARRISBURG, PA 17105
07707	USM CORP., USM FASTENER DIV.	510 RIVER RD.	SHELTON, CT 06484
09922	BURNDY CORPORATION	RICHARDS AVENUE	NORWALK, CT 06852
12327	FREEWAY CORPORATION	9301 ALLEN DRIVE	CLEVELAND, OH 44125
13103	THERMALLOY COMPANY, INC.	2021 W VALLEY VIEW LANE P O BOX 34829	DALLAS, TX 75234
22526	BERG ELECTRONICS, INC.	YOUK EXPRESSWAY	NEW CUMBERLAND, PA 17070
49671	RCA CORPORATION	30 ROCKEFELLER PLAZA	NEW YORK, NY 10020
73743	FISCHER SPECIAL MFG. CO.	446 MORGAN ST.	CINCINNATI, OH 45206
76854	OAK INDUSTRIES, INC., SWITCH DIV.	S. MAIN ST.	CRYSTAL LAKE, IL 60014
78189	ILLINOIS TOOL WORKS, INC. SHAKEPROOF DIVISION	ST. CHARLES ROAD	ELGIN, IL 60120
80009	TEKTRONIX, INC.	P O BOX 500	BEAVERTON, OR 97077
83385	CENTRAL SCREW CO.	2530 CRESCENT DR.	BROADVIEW, IL 60153
87308	N. L. INDUSTRIES, INC., SOUTHERN SCREW DIV.	P. O. BOX 1360	STATESVILLE, NC 28677
91500	ASHEVILLE-SCHOONMAKER MICA CO.	910 JEFFERSON AVE., PO BOX 318	NEWPORT NEWS, VA 23607
91836	KINGS ELECTRONICS CO., INC.	40 MARBLEDALE ROAD	TUCKAHOE, NY 10707
93907	TEXTRON INC. CAMCAR DIV	600 18TH AVE	ROCKFORD, IL 61101
95987	WECKESSER CO., INC.	4444 WEST IRVING PARK RD.	CHICAGO, IL 60641
97464	INDUSTRIAL RETAINING RING CO.	57 CORDIER ST.	IRVINGTON, NJ 07111

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-1	200-2530-00			2		COVER,CAL FXTR:UPPER & LOWER,AL	80009	200-2530-00
						(ATTACHING PARTS)		
-2	211-0244-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
						- - - * - - -		
-3	337-1399-00			2		SHLD,ELECTRICAL:SIDE	80009	337-1399-00
-4	366-1690-00			1		KNOB,LATCH:SIL GY,0.53 X0.23 X 1.059	80009	366-1690-00
-5	105-0719-00			1		LATCH,RETAINING:PLUG-IN	80009	105-0719-00
						(ATTACHING PARTS)		
-6	213-0113-00			1		SCR,TPG,THD FOR:2-32 X 0.312 INCH,PNH STL	93907	OBD
						- - - * - - -		
-7	105-0718-01			1		BAR,LATCH RLSE:	80009	105-0718-01
-8	366-1189-00			1		KNOB:GRAY	80009	366-1189-00
-9	366-0379-00			1		KNOB:GRAY,MODE	80009	366-0379-00
-10	426-1072-00			26		FRAME,PUSH BTN:PLASTIC	80009	426-1072-00
-11	426-0916-00			1		FRAME,RDOUT WDO:	80009	426-0916-00
-12	331-0314-00			1		WINDOW,READOUT:RED	80009	331-0314-00
-13	333-2677-00			1		PANEL,FRONT:	80009	333-2677-00
						(ATTACHING PARTS)		
-14	210-0586-00			3		NUT,PL,ASSEM WA:4-40 X 0.25,STL CD PL	83385	OBD
						- - - * - - -		
-15	333-2678-00			1		PANEL,REAR:	80009	333-2678-00
						(ATTACHING PARTS)		
-16	386-3657-01			2		SUPPORT,PLUG IN:	93907	OBD
-17	211-0534-00			2		SCR,ASSEM,WSHR:6-32 X 0.312 INCH,PNH STL	83385	OBD
-18	213-0192-00			2		SCR,TPG,THD FOR:6-32 X 0.50 INCH,PNH STL	87308	OBD
						- - - * - - -		
-19	426-1761-00			1		FRAME SECT,CAB:UPPER	80009	426-1761-00
						(ATTACHING PARTS)		
-20	211-0244-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-21	213-0229-00			2		SCR,TPG,THD FOR:6-20 X0.375"100 DEG,FLH STL	93907	OBD
						- - - * - - -		
-22	----- -----			1		CKT BOARD ASSY:LOGIC(SEE A4 REPL)		
						(ATTACHING PARTS)		
-23	211-0244-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-24	220-0455-00			4		NUT,BLOCK:0.281"SQ,THREE 4-40 THRU THDS	80009	220-0455-00
						- - - * - - -		
	----- -----			-		. LOGIC BOARD ASSY INCLUDES:		
-25	210-0997-00			4		. WASHER,FLAT:0.042 ID X 0.135 OD	80009	210-0997-00
-26	136-0751-00			1		. SKT,PL-IN ELEK:MICROCKT,24 PIN	09922	D1LB24P-108
	----- -----			-		. (UNDER A4U)		
-27	131-0589-00			102		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-28	----- -----			1		RES.,VAR:20K(SEE R36 REPL)		
						(ATTACHING PARTS)		
-29	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-30	210-0046-00			1		WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						- - - * - - -		
-31	175-3698-00			1		CABLE ASSY,RF:50 OHM COAX,6.0 L,6-1	80009	175-3698-00
-32	131-0818-00			1		. CONNECTOR,RCPT,:BNC,FEMALE	91836	KC19-153BNC
-33	175-1202-00			1		. CABLE,RF:50 OHM COAX,LT BLUE VINYL JKT	80009	175-1202-00
-34	131-0622-00			1		. CONTACT,ELEC:0.577"L,28-32 AWG WIRE	22526	46241
	131-0792-00			1		. CONNECTOR,TERM:18-20 AWG,CU BE GOLD PL	22526	46221
-35	352-0198-02			1		. HLDR,TERM CONN:2 WIRE RED	80009	352-0198-02
-36	386-4465-00			1		SUBPANEL,FRONT:	80009	386-4465-00
-37	386-2173-00			1		SPRT,KNOB ASSY:VAR RES ZERO	80009	386-2173-00
						(ATTACHING PARTS)		
-38	211-0109-00			2		SCREW,MACHINE:4-40 X 0.875"100 DEG,FLH STL	83385	OBD
						- - - * - - -		
-39	200-1339-00			1		COVER,HOUSING:VARIABLE RESISTOR	80009	200-1339-00
-40	214-1702-00			1		SPR,HLCL,TRSN:0.215 INCH OD	80009	214-1702-00
-41	358-0465-00			1		SPACER,SLEEVE:0.13 ID X 0.18 L,SST,0.155	80009	358-0465-00
-42	384-1130-00			1		EXTENSION SHAFT:VAR RES ZERO	80009	384-1130-00
-43	380-0273-00			1		HOUSING,SHAFT:GRAY ACETAL	80009	380-0273-00
-44	354-0165-00			1		RING,RETAINING:0.114 FREE IDX 0.025 INCH	97464	1000-15
-45	210-0949-00			2		WASHER,FLAT:0.141 ID X 0.50 INCH OD,BRS	12327	OBD
-46	376-0014-00			1		CPLG,SHAFT,FLEX:SST WIRE	76854	22675-001

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-47	----- -----			1		RES.,VAR:10K(SEE R11 REPL)		
						(ATTACHING PARTS)		
-48	210-0583-00			1		NUT,PLAIN,HEX.:0.25-32 X 0.312 INCH,BRS	73743	2X20317-402
-49	210-0046-00			1		WASHER,LOCK:0.261 ID,INTL,0.018 THK,BRS	78189	1214-05-00-0541C
						- - - * - - -		
-50	----- -----			1		SWITCH,BCD:(SEE S15,35,55,75 REPL)		
						(ATTACHING PARTS)		
-51	211-0112-00			4		SCREW,MACHINE:2-56 X 0.375,FLH,100 DEG	83385	OBD
-52	210-0405-00			4		NUT,PLAIN,HEX.:2-56 X 0.188 INCH,BRS	73743	2X12157-402
-53	210-0001-00			4		WASHER,LOCK:INTL,0.092 ID X 0.18"OD,STL	78189	1202-00-00-0541C
						- - - * - - -		
-54	131-1807-00			1		CONTACT ASSY,EL:31,0.025 SQ,0.15 CTR,0.54L	22526	65603-131
-55	----- -----			1		CKT BOARD ASSY:DISPLAY(SEE A2 REPL)		
						(ATTACHING PARTS)		
-56	211-0244-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
						- - - * - - -		
	----- -----			-		. DISPLAY BOARD ASSY INCLUDES:		
-57	131-0589-00			26		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-58	136-0494-00			4		. SKT,PL-IN ELEK:MICROCIRCUIT,14 DIP		
-59	179-2746-00			1		WIRING HARNESS:MAIN	80009	179-2746-00
-60	131-0707-00			2		. CONNECTOR,TERM.:22-26 AWG,BRS& CU BE GOLD	22526	47439
-61	352-0169-09			1		. CONN BODY,PL,EL:2 WIRE WHITE	80009	352-0169-09
-62	131-0621-00			204		. CONNECTOR,TERM:22-26 AWG,BRS& CU BE GOLD	22526	46231
-63	352-0201-04			1		. HLDR,TERM CONN:5 WIRE YELLOW	80009	352-0201-04
-64	352-0201-05			1		. CONN BODY,PL,EL:5 WIRE GREEN	80009	352-0201-05
-65	352-0201-06			1		. CONN BODY,PL,EL:5 WIRE BLUE	80009	352-0201-06
-66	352-0201-07			1		. CONN BODY,PL,EL:5 WIRE VIOLET	80009	352-0201-07
-67	352-0202-04			1		. CONN BODY,PL,EL:6 WIRE YELLOW	80009	352-0202-04
-68	352-0202-05			1		. CONN BODY,PL,EL:6 WIRE GREEN	80009	352-0202-05
-69	352-0202-06			1		. CONN BODY,PL,EL:6 WIRE BLUE	80009	352-0202-06
-70	352-0202-07			1		. CONN BODY,PL,EL:6 WIRE VIOLET	80009	352-0202-07
-71	352-0198-07			1		. CONN BODY,PL,EL:2 WIRE PURPLE	80009	352-0198-07
-72	352-0206-00			1		. HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00
-73	352-0206-01			1		. HLDR,TERM CONN:10 WIRE BROWN	80009	352-0206-01
-74	352-0206-05			1		. HLDR,TERM CONN:10 WIRE GREEN	80009	352-0206-05
-75	352-0206-04			1		. HLDR,TERM CONN:10 WIRE YELLOW	80009	352-0206-04
-76	352-0199-04			1		. CONN BODY,PL,EL:3 WIRE YELLOW	80009	352-0199-04
-77	352-0201-03			1		. CONN BODY,PL,EL:5 WIRE ORANGE	80009	352-0201-03
-78	352-0201-02			1		. CONN BODY,PL,EL:5 WIRE RED	80009	352-0201-02
-79	352-0206-03			1		. HLDR,TERM CONN:10 WIRE ORANGE	80009	352-0206-03
-80	352-0206-02			1		. CONN BODY,PL,EL:10 WIRE RED	80009	352-0206-02
-81	352-0199-02			1		. CONN BODY,PL,EL:3 WIRE RED	80009	352-0199-02
-82	352-0206-06			1		. HLDR,TERM CONN:10 WIRE BLUE	80009	352-0206-06
-83	352-0201-02			1		. CONN BODY,PL,EL:5 WIRE RED	80009	352-0201-02
-84	352-0201-03			1		. CONN BODY,PL,EL:5 WIRE ORANGE	80009	352-0201-03
-85	352-0203-00			1		. HLDR,TERM CONN:7 WIRE BLACK	80009	352-0203-00
-86	352-0206-07			1		. HLDR,TERM CONN:10 WIRE VIOLET	80009	352-0206-07
-87	352-0206-02			1		. CONN BODY,PL,EL:10 WIRE RED	80009	352-0206-02
-88	352-0206-03			1		. HLDR,TERM CONN:10 WIRE ORANGE	80009	352-0206-03
-89	352-0198-09			1		. CONN BODY,PL,EL:2 WIRE WHITE	80009	352-0198-09
-90	352-0206-01			1		. HLDR,TERM CONN:10 WIRE BROWN	80009	352-0206-01
-91	352-0206-00			1		. HLDR,TERM CONN:10 WIRE BLACK	80009	352-0206-00
-92	352-0203-00			1		. HLDR,TERM CONN:7 WIRE BLACK	80009	352-0203-00
-93	214-3087-00			1		HEAT SINK,XSTR:(3) TO -220	80009	214-3087-00
						(ATTACHING PARTS)		
-94	211-0534-00			2		SCR,ASSEM,WSHR:6-32 X 0.312 INCH,PNH STL	83385	OBD
						- - - * - - -		
-95	210-0406-00			3		NUT,PLAIN,HEX.:4-40 X 0.188 INCH,BRS	73743	2X12161-402
-96	210-1178-00			3		WSHR,SHOULDERED:FOR MTG TO-220 TRANSISTOR	49671	DF 137A
-97	342-0202-00			3		INSULATOR,PLATE:TRANSISTOR,MICA	91500	10-21-023-106
-98	----- -----			1		CKT BOARD ASSY:DAC(SEE A3 REPL)		
						(ATTACHING PARTS)		
-99	211-0244-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
-100	220-0455-00			4		NUT,BLOCK:0.281"SQ,THREE 4-40 THRU THDS	80009	220-0455-00
						- - - * - - -		

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
1-	----- -----			-		. DAC BOARD ASSY INCLUDES:		
-101	----- -----			3		. TRANSISTORS:(SEE Q391,Q395,Q397 REPL)		
-102	131-0589-00			47		. TERM,PIN:0.46 L X 0.025 SQ.PH BRZ GL	22526	47350
-103	136-0261-00			10		. SOCKET,PIN TERM:FOR 0.22 INCH PIN	00779	1-331677-6
-104	131-0608-00			11		. TERMINAL,PIN:0.365 L X 0.025 PH BRZ GOLD	22526	47357
-105	131-0993-00			1		. BUS,CONDUCTOR:2 WIRE BLACK	00779	530153-2
-106	136-0252-07			48		. SOCKET,PIN CONN:W/O DIMPLE	22526	75060-012
-107	198-2868-00			1		. WIRE SET,ELEC:	80009	198-2868-00
-108	----- -----			1		. SWITCH:8 BUTTON(SEE A3S326 REPL)		
-109	----- -----			5		. SWITCH:(SEE A3S310,311,312,313,314 REPL)		
-110	343-0499-03			1		. CLIP,SWITCH:7.5 MM,4 UNIT	80009	343-0499-03
-111	210-3033-00			13		. EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
-112	343-0499-05			2		. CLIP,SWITCH:REAR,7.5MM X 5 UNIT	80009	343-0499-05
-113	210-3033-00			13		. EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
-114	343-0495-05			1		. CLIP,SWITCH:FRONT,7.5MM X5 UNIT	80009	343-0495-05
-115	343-0495-08			1		. CLIP,SWITCH:FRONT,7.5MM X8 UNIT	80009	343-0495-08
-116	342-0324-00			4		. INSULATOR,DISC:TO-5 TRANSISTOR	13103	7717-5N-BLUE
	----- -----			-		. (UNDER A3U368,Q392,Q396,Q398)		
-117	----- -----			1		CKT BOARD ASSY:SWITCH(SEE A1 REPL)		
						(ATTACHING PARTS)		
-118	211-0007-00			6		SCREW,MACHINE:4-40 X 0.188 INCH,PNH STL	83385	OBD
-119	129-0517-00			3		POST,ELEC-MECH:0.25 L X 0.25 HEX,AL	80009	129-0517-00
						- - - * - - -		
	----- -----			-		. SWITCH BOARD ASSY INCLUDES:		
-120	131-0787-00	B010100 B010119		15		. TERMINAL PIN:0.64 L X 0.025 SQ,PH BRZ	22526	47359
	131-0589-00	B010120		15		. TERMINAL PIN:0.46 L X 0.025 SQ PH BRZ	22526	47350
-121	343-0499-03			1		. CLIP,SWITCH:7.5 MM,4 UNIT	80009	343-0499-03
-122	343-0499-05			2		. CLIP,SWITCH:REAR,7.5MM X 5 UNIT	80009	343-0499-05
-123	210-3033-00			13		. EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
-124	----- -----			1		. SWITCH:8 BUTTON(SEE A1S116 REPL)		
-125	----- -----			1		. SWITCH:5 BUTTON(SEE A1S112 REPL)		
-126	343-0495-08			1		. CLIP,SWITCH:FRONT,7.5MM X8 UNIT	80009	343-0495-08
-127	210-3033-00			13		. EYELET,METALLIC:0.59 OD X 0.156 INCH LONG	07707	SE-25
-128	343-0495-05			1		. CLIP,SWITCH:FRONT,7.5MM X5 UNIT	80009	343-0495-05
-129	366-1512-00			26		PUSH BUTTON:GRAY,0.18 SQ X 0.83 INCH LG	80009	366-1512-00
-130	426-1762-00			1		FRAME SECT,CAB:LOWER	80009	426-1762-00
						(ATTACHING PARTS)		
-131	211-0244-00			4		SCR,ASSEM WSHR:4-40 X 0.312 INCH,PNH STL	78189	OBD
	213-0229-00			2		SCREW,TPG,TF:6-20 X 0.375,TYPE B,FLH 100 DEG	93907	OBD
						- - - * - - -		
-132	343-0013-00			1		CLAMP,LOOP:0.375 INCH DIA	95987	3-8-6B
						(ATTACHING PARTS)		
-133	210-0458-00			1		NUT,PL,ASSEM WA:8-32 X 0.344 INCH,STL	78189	511-081800-00
-134	210-0863-00			1		WSHR,LOOP CLAMP:FOR 0.50" WIDE CLAMP,STL	95987	C191
						- - - * - - -		

FIG. 1 EXPLODED



067-0916-00 Video Amplitude Calibration Fixture

Tektronix Part No.	Serial/Model No. Eff	Dscont	Qty	1 2 3 4 5	Name & Description	Mfr Code	Mfr Part Number
					STANDARD ACCESSORIES		
011-0102-01			1		TERMN,COAXIAL:75 OHM,BNC	80009	011-0102-01
011-0134-00			1		ATTENUATOR,FXD:6%	80009	011-0134-00
015-0407-00			1		ACCESSORY ASSY:LOW PASS FILTER	80009	015-0407-00
070-3643-00			1		MANUAL,TECH:INSTRUCTION	80009	070-3643-00
					OPTIONAL ACCESSORIES		
012-0159-01			1		CABLE ASSY,RF:75 OHM COAX,72.0 L	80009	012-0159-01

REPORT OF VAC CALIBRATION

Instructions

Use the Performance Check Procedure steps 1 and 3 in the 070-3643-00 "Video Amplitude Calibration Fixture" Instruction Manual to fill out the following tables. A check-off list is provided on page A-3. Initial the corresponding line after each step in the Performance Check Procedure is completed. This must be done to insure the instrument is NBS traceable.

1. Before any adjustments are made to the instrument, record "Pre-cal Value".

2. Circle or write in read all "Out-of-Specification" measurements in Table A-1.

3. After all adjustments, measure and record the "Corrected Value".

VAC Information		DVM Information	
CALIBRATED BY	SERIAL NUMBER	DVM TYPE	SERIAL NUMBER
CAL. DATE	NEXT CAL. DATE	LAST CAL. DATE	NEXT CAL. DATE
TEKTRONIX JOB NUMBER		DVM ACCURACY AT 1 V	

Table A-1

AMPLITUDE TOLERANCE CHECK

Lever Switch Setting (mV)	Specification Tolerance ±(.05% + .1 mV)	Pre-Cal Value (mV)	Corrected Value (mV)
000.0	−0.1 to +0.1		
999.9	999.3 to 1000.49		

Tables A-2 and A-3 are to be filled out after recalibration of the VAC.

Table A-2

DIFFERENTIAL LINEARITY CHECK

Lever Switch Settings		Actual Readings from DVM		Differential Amplitude
V1	V2	a_{V1}	a_{V2}	$a_{V2} - a_{V1}$
000.0	000.1			
000.1	000.2			
000.3	000.4			
000.7	000.8			
000.9	001.0			
001.9	002.0			
003.9	004.0			
007.9	008.0			
009.9	010.0			
019.9	020.0			
039.9	040.0			
079.9	080.0			
099.9	100.0			
199.9	200.0			
399.9	400.0			
799.9	800.0			

$$V_{actual} - V_{offset} - \frac{V_{desired}}{999.9} (V_{fullscale} - V_{offset}) = \text{Absolute Linearity Error}$$

Table A-3

ABSOLUTE LINEARITY

Lever Switch Setting ($V_{desired}$)	Actual Reading (mV) (V_{actual})	Absolute Linearity Error
250.0 mV		
500.0 mV		
750.0 mV		

PERFORMANCE CHECK LIST

_____ 1. Check Amplitude Range, Lever Switches.

_____ 2. Check TOLERANCE Control.

_____ 3. Check Absolute and Differential Linearity.

_____ 4. Check Preset Group, Preset Level, System Select, and Amplitude Setup Functions.

_____ 5. Check Noise.

_____ 6. Check +LUM, −SYNC, CHR P-P, VARIABLE, RESET.

_____ 7. Check Risetime.

_____ 8. Check Output Frequency.

@

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Since the change information sheets are carried in the manual until all changes are permanently entered, some duplication may occur. If no such change pages appear following this page, your manual is correct as printed.

SERVICE NOTE

Because of the universal parts procurement problem, some electrical parts in your instrument may be different from those described in the Replaceable Electrical Parts List. The parts used will in no way alter or compromise the performance or reliability of this instrument. They are installed when necessary to ensure prompt delivery to the customer. Order replacement parts from the Replaceable Electrical Parts List.

CALIBRATION TEST EQUIPMENT REPLACEMENT

Calibration Test Equipment Chart

This chart compares TM 500 product performance to that of older Tektronix equipment. Only those characteristics where significant specification differences occur, are listed. In some cases the new instrument may not be a total functional replacement. Additional support instrumentation may be needed or a change in calibration procedure may be necessary.

Comparison of Main Characteristics

DM 501 replaces 7D13		
PG 501 replaces 107	PG 501 - Risetime less than 3.5 ns into 50 Ω.	107 - Risetime less than 3.0 ns into 50 Ω.
108	PG 501 - 5 V output pulse; 3.5 ns Risetime	108 - 10 V output pulse 1 ns Risetime
PG 502 replaces 107		
108	PG 502 - 5 V output	108 - 10 V output
111	PG 502 - Risetime less than 1 ns; 10 ns Pretrigger pulse delay	111 - Risetime 0.5 ns; 30 to 250 ns Pretrigger pulse delay
PG 508 replaces 114	Performance of replacement equipment is the same or better than equipment being replaced.	
115		
2101		
PG 506 replaces 106	PG 506 - Positive-going trigger output signal at least 1 V; High Amplitude output, 60 V.	106 - Positive and Negative-going trigger output signal, 50 ns and 1 V; High Amplitude output, 100 V.
067-0502-01	PG 506 - Does not have chopped feature.	0502-01 - Comparator output can be alternately chopped to a reference voltage.
SG 503 replaces 190, 190A, 190B	SG 503 - Amplitude range 5 mV to 5.5 V p-p.	190B - Amplitude range 40 mV to 10 V p-p.
191		
067-0532-01	SG 503 - Frequency range 250 kHz to 250 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
SG 504 replaces 067-0532-01	SG 504 - Frequency range 245 MHz to 1050 MHz.	0532-01 - Frequency range 65 MHz to 500 MHz.
067-0650-00		
TG 501 replaces 180, 180A	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	180A - Trigger pulses 1, 10, 100 Hz; 1, 10, and 100 kHz. Multiple time-marks can be generated simultaneously.
181		181 - Multiple time-marks
184	TG 501 - Trigger output-slaved to market output from 5 sec through 100 ns. One time-mark can be generated at a time.	184 - Separate trigger pulses of 1 and 0.1 sec; 10, 1, and 0.1 ms; 10 and 1 μs.
2901	TG 501 - Trigger output-slaved to marker output from 5 sec through 100 ns. One time-mark can be generated at a time.	2901 - Separate trigger pulses, from 5 sec to 0.1 μs. Multiple time-marks can be generated simultaneously.

NOTE: All TM 500 generator outputs are short-proof. All TM 500 plug-in instruments require TM 500-Series Power Module.